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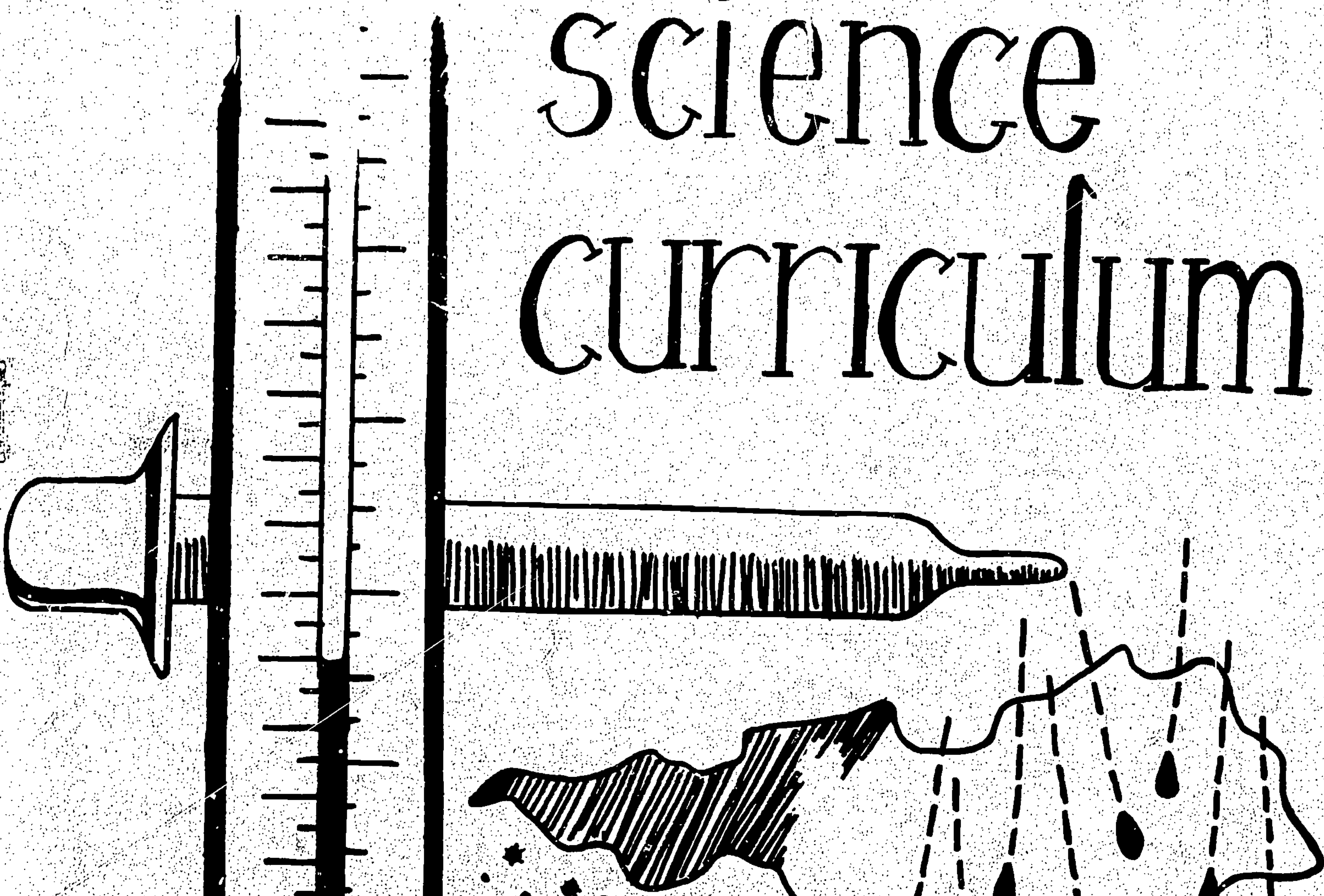
ABSTRACT

This is one of a set of curriculum guides for the Stoneham Elementary School Science Program (see SE 012 153 - SE 012 158). Each guide contains a chart illustrating the scope and sequence of the physical, life, and earth sciences introduced at each grade level. For each of the topics introduced at this grade level, an overview of the topic, a list of concepts to be developed, motivating ideas, suggested activities to develop each concept, a reading list, a list of supplies needed, and examples of student work sheets are provided. In most activities, the teacher is expected to involve all students in experimenting and applying scientific thinking. The topics covered in the grade three guide are: magnets, the water cycle and clouds, composition and structure of the earth, the earth in space, simple machines (inclined planes, levers, pulleys), and ecological communities. (AL)

Transfer: ERIC/Science

Elementary science curriculum



stoneham, mass.

grade 3

STONEHAM PUBLIC SCHOOLS

STONEHAM, MASSACHUSETTS

ELEMENTARY SCIENCE CURRICULUM GUIDE

GRADE 3

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Introduction to Grade 3 Curriculum

These units were written as guides for teaching science in third grade. The activities suggested are given to assist the teacher in illustrating the given concepts. In some instances several activities are suggested for one concept. It is not expected that the teacher use all these activities, but only those which will best suit her class. In other cases the activities suggested follow a particular sequence which would encompass several days illustrating several related subconcepts along the way. It is not expected that the third grade teacher stick rigidly to her curriculum guide. If deviating to include another concept, however, the teacher is advised to consult other Stoneham Science Curriculum Guides to be certain that the concept is not introduced at another grade level. The teacher is encouraged to have reference materials in the classroom at all times for each unit.

Whenever possible, the teacher is expected to involve all the children in experimenting and encouraging application of the scientific method and thinking. This would involve the following skills:

1. to formulate hypothesis
2. to reason quantitatively
3. to evaluate critically
4. to draw conclusions
5. to select procedures
6. to define problems
7. to create charts and keep records
8. to use equipment effectively

It is intended that the teacher will adequately adapt this guide to her own class needs.

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STATEMENT OF PHILOSOPHY

We have all experienced the confusion of sorting out events that come at us, seemingly, haphazardly. We try to perceive the link, the relationship, that will make everything clear, that will help us decide. In fact, from the time we are born the main activity of our lives is trying to sense some order in our constantly changing world. Science is a tool that man uses to seek order. Modern science has evolved not only as a body of fact, but also as a logical approach to problem solving. In the elementary school this aspect of science should not be overlooked. The study of science should encourage growth in the ability to solve problems, as well as introduce a background of knowledge.

To achieve this goal the emphasis must shift away from the teaching of "facts" to the development of such abilities as: observation, collection of information, classification, formation of hypotheses, data interpretation, generalization, and prediction. Thus the process of learning becomes just as important as the information obtained.

This approach to teaching science transforms the classroom into a laboratory and the children into scientists working within it. The teacher provides enough orientation so that the children develop goals of their own, and guides them through concrete experiences that nurture both technique and knowledge of facts. There are many outcomes of a lesson: skills, facts, aroused curiosity, ideas, and discovery of new relationships. The pupils gain confidence in their own ability to learn, a process which will be valuable long after the facts are forgotten.

SCOPE AND SEQUENCE CHART

		GRADE I	GRADE 2	GRADE 3
PHYSICAL	Chemistry	Changes in Matter melting freezing heating	Changes in Matter solid liquid gas molecular	
	Physics	Magnets push and pull		Magnets attraction repulsion Simple Machines their uses relationships of applied force
LIFE	Human Body	Growth bones teeth nutrition health	Growth muscles skeletal structure emotions	
	Plants	Reproduction seeds bulbs spores regeneration	Life Activities structure classification seed plants non-seed plants	Ecosystem pond community
	Animals	Classification vertebrates	Life Activities life cycle insects brine shrimp	

SCOPE AND SEQUENCE CHART

GRADE 4	GRADE 5	GRADE 6
Molecular Theory matter molecules energy - relations		
Electricity static-current production conductors **Sound** waves, vibration, pitch, reflection	**Heat** motion expansion-contraction conduction, convection insulators	**Light** photons- reflection waves color
The Ear producing and hearing sounds	**Cellular Organization** cells tissues organs	**Genetics** heredity genetic code dominant and recessive traits
		Photosynthesis leaf structure carbon cycle
Simple and Complex 5 basic life-processes cellular structure classification		**Animal Behavior** inherited and learned **Ecology** balance in nature disbalance

SCOPE AND SEQUENCE CHART

	GRADE 1	GRADE 2	GRADE 3
Astronomy E A R T H	<u>Earth - Sun - Moon</u> rotation day and night		<u>Solar System</u> orbits revolutions seasonal change
Geology		<u>Fossils</u> dinosaurs fuels evolution	<u>Earth Composition</u> soil rock formation classification
Meteorology	<u>Changes in Weather</u> clouds		<u>Water Cycle</u> cloud formation precipitation weather prediction

SCOPE AND SEQUENCE CHART

	GRADE 4	GRADE 5	GRADE 6
		<u>Forces in Space</u> centrifugal centripetal gravitational	<u>Motion in Space</u> movement of plants parallax, triangulation gallaxies atomic energy
		<u>Earth Changes</u> surface interior <u>Ocean Environment</u> water food life exploration	
	<u>Influence on Man</u> air ingredients of weather effects of weather		

MAGNETIC FORCE

Objective:

1. To familiarize students with magnetic properties so that they may infer how magnets help us do work.

2. To understand how magnetic force indicates direction.

3. Promote scientific thinking.

Concepts to be Developed

1. Magnets may vary in shapes and sizes.

2. Magnets attract things made with iron and steel.

3. A magnetic field is the region around a magnet in which a magnetic effect is produced. The field is most powerful at the magnets ends or poles.

4. The force of magnetism can attract through many materials.

5. A magnet can be made only out of those materials that are themselves attracted to a magnet.

6. All magnets have two ends called poles.

7. A suspended magnet will align itself in a north-south direction due to the earth's magnetic poles.

8. Dropping, heating or storing a magnet improperly will weaken its force.

Motivation

1. Ask children to bring magnetic toys to class which they have at home. Let each child who brings one demonstrate how it works. Allow them to tell why the toys function as they do. *Skillful questions by the teacher will help reveal what the children already know about magnets from previous experience. Try to find the magnet in each toy.

2. Arrange a display of various types of magnets including a natural magnet, lodestone. Have available things that will be attracted and things that will not. Observe questions asked and general knowledge evident and adapt unit accordingly.

3. Show film Michael Discovers the Magnet

Activities for: Magnets Have Force

1. MAGNETS MAY VARY IN SHAPES AND SIZES

   A. Make a collection of magnets. Several bar magnets, a horseshoe magnet, a U-magnet and a lodestone are desirable. Have the children examine the different kinds of magnets. *Select a child to find out more about lodestones in reference books.

2. MAGNETS ATTRACT THINGS MADE OF IRON AND STEEL

   A. Materials: several magnets, 3-inch string, numerous attractable objects (have several non-attractable metals).

   Procedure: Pose this problem or facsimile: A boy dropped his penny into a grating and wanted to get it back. How could he get it? (Could a magnet on a string help him?) Take a vote and then try it. After failure to attract, make hypothesis on whether the following will be attracted:

	Name	Made of	We Think	We Found Out
1.	nails	iron	______	________
2.	comb	rubber	______	________
3.	pins	steel	______	________
4.	hair curler	alumin.	______	________
5.	penny	bronze	______	________
6.	scissors	steel	______	________
7.	coat hanger	iron	______	________
	(etc.)			

   Conclusions: Guide the children to observe that the objects tested successfully were made of iron or steel. A magnet could not retrieve a penny but one of sufficient strength could retrieve an object made of iron or steel.

   B. Materials: nail file (or small coarse rock), magnet, several identical appearing straight pins of steel and brass. (Test with magnet to determine which are steel).

   Procedure: Ask someone to put some straight pins in a box. Have them use a magnet to make the task "easier." When failure is experienced with the brass pins, let the children first define the problem, then raise hypothesis as to why failure occurred. Attracted and unattracted pins may be rubbed against a nail file or rough stone. As the thin coating is

worn away, steel pins will appear dull gray and brass pins will appear yellowish. Let the test continue until a pattern develops. All attracted pins will be one color, all unattracted pins another. This will help verify the hypothesis.

Conclusions: Bring out that some pins were made of steel and some of brass - a metal that is not attracted by magnetism.

C. Encourage children to bring in other materials and magnets that have not been tested. This is an open-end activity. Follow a similar hypothesis-test procedure.

3. A MAGNETIC FIELD IS THE REGION AROUND A MAGNET IN WHICH A MAGNETIC EFFECT IS PRODUCED. THE FIELD IS MOST POWERFUL AT THE MAGNETS END, OR POLES.

A. Materials: container of iron filings (salt shaker) or a handful of tiny nails; a sheet of stiff white paper; several paper clips; a powerful magnet.

Procedure: (Motivation) - How close must a magnet be to attract iron or steel things? Allow several children to try different distances with a magnet and paper clips. Have them determine which part of the magnet appears most powerful. If several magnets of differing strengths are available, let the children show that some will attract over a greater distance than others. "How is it possible for these magnets to pick up things without touching them?" Lay a magnet on a table and place the white paper over it. Explain that the container holds small bits of iron called "filings." Sprinkle some filings on the paper above the magnet. Tap the paper gently to assist in distribution of filings. Have the children observe the orderly arrangement of filings around the magnet. Tell them that this is the magnet's field of force.

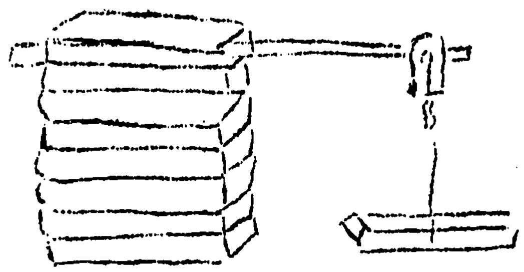
Conclusions: Concentration of lines of force seem greatest at the poles. Bring out that this is probably why the ends of the magnet seemed more powerful than its other parts.

B. Make permanent records of lines of force with different magnets. Sprinkle iron filings on blueprint paper laid over a magnet. Place carefully in a sunny area without disturbing the pattern. Expose 5 or 10 minutes. Brush or shake filings off and run cold water over blueprint. A permanent record of lines of force will be recorded.

4. THE FORCE OF MAGNETISM CAN ATTRACT THROUGH MANY MATERIALS.

A. Materials: flat, thin pieces of glass, steel (can tops), plastic, aluminum or aluminum foil, wood, etc.; magnet; string; paper clip; ruler; books.

Procedure: Place the objects on a table and set up magnet as below - leaving out the paper clip to begin with.



(Motivation) - Once a man had a water pipe leak in his house. The pipe was inside a wall and he could not find it. He didn't want to tear down his wall just to find the pipe. What could he do? If no one guesses, have children recall previous demonstration where iron filings were attracted through paper. Continue questioning until it is reasoned that perhaps a magnet's field of force could go through a wall. Suspend paper clip and illicit that the magnetic field is attracting through the air. Allow students to suggest a way to use and set up objects on table to determine if magnetism will go through things. Have the children try slipping various flat objects in the space between the magnet and paper clip. Relate findings to initial problem.

Conclusions: When a can top is placed in the space, they will note the paper clip falls. Guide to understand that magnetism will penetrate non-magnetic materials, but will not pass through magnetic materials unless an attracted object is actually touching them.

* B. Fill a glass dish with water. Place some tacks in the water. Have the child get the tacks out of the water without wetting his hands.

5. A MAGNET CAN BE MADE ONLY OUT OF THOSE MATERIALS THAT ARE THEMSELVES ATTRACTED TO A MAGNET.

A. Materials: several large and small nails; magnets; steel straight pins; paper clips; steel knitting needles; screwdriver; or similar objects.

Procedure: Allow children to examine materials to see if they attract one another. Are they attracted by a magnet? Using one magnet, see if a chain of nails can be built. If magnet is strong enough, the chain will be easily made.

Conclusions: Magnets can be made out of iron and steel objects.

B. Materials: Magnet, large nail or steel knitting needle.

Procedure: Show that the nail is not a magnet by touching it to a paper clip. With either pole of a magnet, stroke the nail its entire length in one direction only. Call this to the children's attention. Lift the magnet at the end of each stroke for 20 or 30 strokes. Demonstrate that the object is now a magnet.

Conclusions: A magnet can magnetize a magnetic object.

C. Will a nail's magnetism get more powerful the more it is stroked? (Test after each 10 strokes with a magnet.)

D. Which can be magnetized more easily - a soft iron nail or a knitting needle made of hard steel? (Each object is first tested for magnetism, stroked once before each test, tested again with paper clips, and so on.)

E. Which will keep its strength longer - the magnetized, soft iron nail, or the magnetized needle made of hard steel? (Same procedure as above is followed, except that objects are initially stroked more times and tested after a five minute or longer interval.)

F. Will a magnet you make be more powerful if stroked in one direction or back and forth in two directions? (Use two identical nails. Test to see if magnetized. Stroke both 30 times - one in both directions and one 15 times each way. Test with paper clips.)

6. ALL MAGNETS HAVE 2 ENDS, CALLED POLES. THE POLES ARE LABELED N (NORTH) AND S (SOUTH). IF 2 UNLIKE POLES ARE BROUGHT TOGETHER, THEY ATTRACT ONE ANOTHER. TWO LIKE POLES WILL REPEL ONE ANOTHER.

A. Materials: 2 magnets, which have marked poles; string

Procedure: Suspend one magnet on a string so that it will be free to move. Bring one pole of the second magnet within the field of force of the suspended one. Allow children to observe the attraction of opposite poles and the repelling of 2 like poles.

Conclusion: Opposite poles attract each other. Like poles repel one another. Opposite fields of force attract and like fields of force repel.

B. Materials: shallow pan, water, cork, stiff paper, magnatized needle.

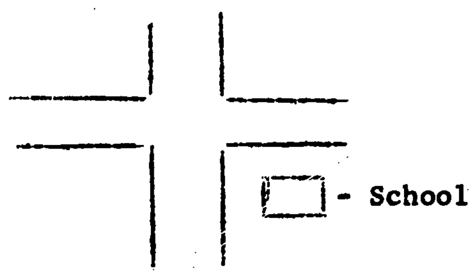
Procedure: Make a boat of cork, stiff paper and magnetized needle. Allow the children to experiment with their magnets in moving the boat. (When boat is pulled the magnet attracts it. When boat is pushed, the magnet repels it.

Conclusion: The fields of force are attracting and repelling.

7. A SUSPENDED MAGNET WILL ALIGN ITSELF IN A NORTH - SOUTH DIRECTION DUE TO THE EARTH'S MAGNETIC POLES. COMPASS NEEDLES ARE FREELY SWINGING MAGNETS.

A. Materials: four cards marked North, East, South, and West.

Procedures Place directional cards in appropriate areas of the room. Have children decide who lives North, South, East and West of the school. Draw a chalkboard sketch of two main streets that are N - S and E - W.



Conclusion: There are four main directions, N - S - E - W.

B. Materials: marked magnet, string

Procedure: Suspend a marked magnet from a string. (Make sure there are no other powerful magnets around.) Observe the direction in which the magnet aligns itself. The north pole of the magnet is facing which direction? (South) It is known as the south-pointing pole. The South pole of the magnet is facing which direction? (North) It is called the north-pointing pole. The magnet's poles are attracted to the earth's magnetic poles.

Conclusion: Magnets can show direction.

C. Materials: Several compasses

Procedure: Allow children to observe that the north-pointing poles of the compass needles point toward the same direction - north.

Conclusion: Compasses show direction.

D. Which pole of the compasses magnet needle points North? Which points South? Why?

E. Why might you want to know which direction is north?

F. How can knowing which direction is north help you find other directions?

8. DROPPING, HEATING, OR STORING A MAGNET IMPROPERLY WILL WEAKEN ITS FORCE.

A. Materials: candle; two identical steel knitting needles; magnets; pliers; paper clips.

Procedure: Make sure knitting needles are magnetized to the same degree. Drop only one magnet 20 - 30 times. This should produce a noticeable difference in its attractive force. Help children to record pre-test and post-test results in this way.

	Dropped Magnet	Other Magnet
Before	5 clips	5 clips
After	3 clips	5 clips

Conclusion: Dropping a magnet will reduce magnetism.

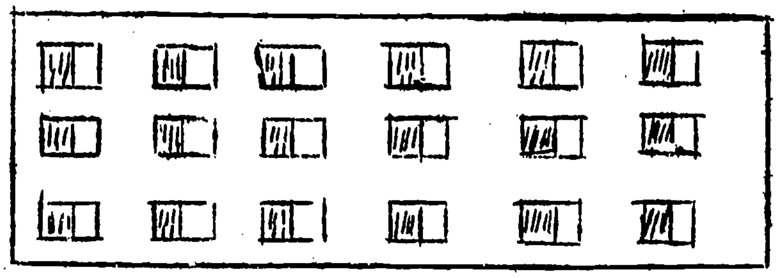
B. Procedure: Re-magnetize needles. Develop a similar procedure with heat as the critical factor. Pliers or tongs could hold magnet while being heated in candle flame. A minute is usually long enough for significant results. Use paper clips for pre-test and post-test comparisons. Test control magnet to affirm conclusions.

C. Why can magnets easily be de-magnetized.

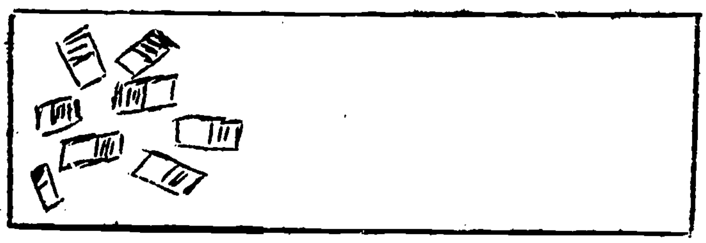
1. Magnets have inside them tiny, invisible particles called domains. Domains don't really resemble the diagram but it is easier for pupils to understand the theory.

2. When domains are lined up, they act like tiny magnets which are pointed in one direction. Stroking a needle or nail with a magnet is one way to arrange them in a line.

3. When heated or jarred, the domains get out of line and repel each other. Storing like poles together pushes the domains out of alignment, too. This causes a magnet to lose some of its force,

N  S

Domains within a magnet



Domains within non-magnetized steel

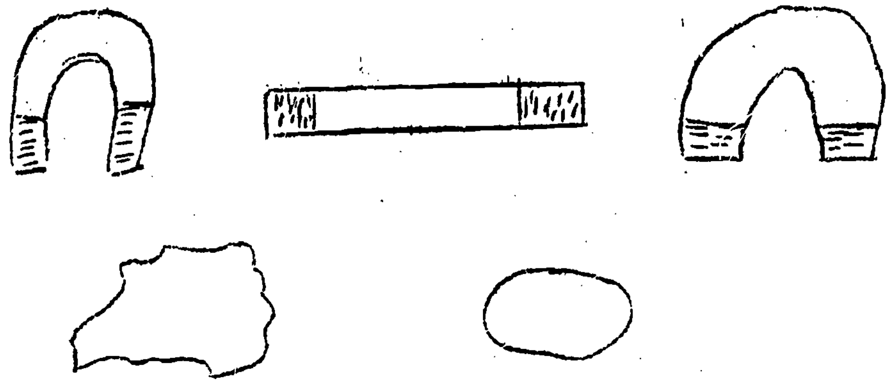
Culminating Activity

Allow children to bring in magnetic objects they are familiar with and explain how they operate.

Worksheet Ideas

Worksheet A

1. Write the name of each type of magnet underneath each picture.



2. Which part of the above magnets are the strongest?

3. Which magnet has greater attraction, a bar or a horseshoe magnet? What makes the difference?

4. With your partner, test the following objects to see which are magnetic and which are not: thumbtack, desk bottom, seat of chair, wall, pencil, (etc.)

Homework extension: Find 10 magnetic items at home and list them.

Worksheet B

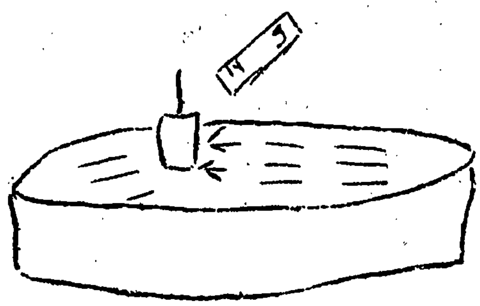
Problem: Mr. Waters is lost in the forest while hunting. He knows that he wants to go east, but doesn't know which direction is "east." He does not have a compass to tell him direction, but he does have a marked magnet. How can Mr. Waters use his marked magnet to help him?

Worksheet C

Problem: Jane has a compass. She wants to go south. Her compass tells her that north is to her right. In which direction should she walk?

Jack is with Jane. He wants to go west. In which direction should he walk?

Worksheet D



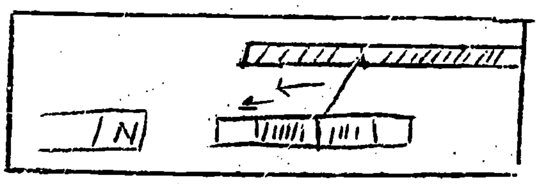
Problem: A magnetized needle is placed into a cork. Why is it moving toward the left in the water?

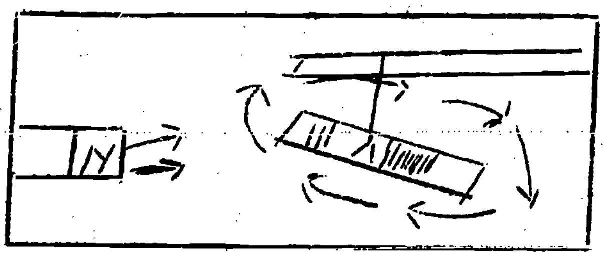
How could we make the cork and needle move toward the right?

Can you think of another way?

Worksheet E

Mark the poles on the magnets in the picture below.

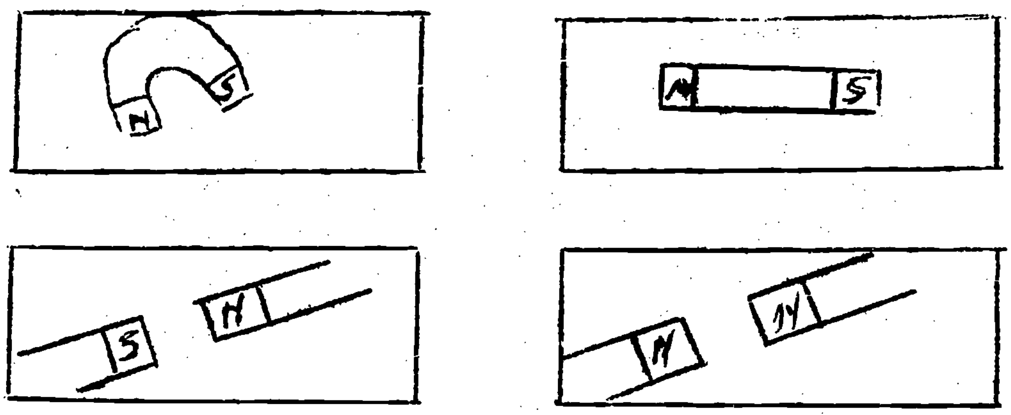




(Similar sketches can be made using a magnet and a compass.)

Worksheet F

Show magnetic fields of force by drawing dashes between the poles of the magnet pictured.



References

1. Carin, Arthur and Robert B. Sund - Teaching Science Through Discovery, Columbus, Ohio, Charles E. Merrill Books, 1966 p. 398-404

2. Craig, Science For You 3, Boston, Ginn & Co., T.Ed., p. 177-197

* 3. Ferarolo, Rocco V., Junior Science Book of Magnets, Garrad, 1960.

4. Gega, Peter C., Science in El. Ed., New York, John Wiley & Sons, Inc., 1966, p. 191-196

* 5. Parker, Bertha, Magnets, Row Peterson, 1944.

6. Singer, Science Through Discovery 3, Random House T. Ed., p. 173-187, P. Ed., 178-194

7. Thurber & Durkee, Exploring Science 3, Boston, Allyn & Bacon, Inc., T. Ed., p. 82-89, P.Ed., 161-176

* 8. Yates, Raymond, A Boy's Book of Magnetism, Harper, 1941.

* Indicates children's books

Films

1. Michael Discovers the Magnet - (E B F)
2. The Story of Magnetism (U W F)

Filmstrips

1. Different Kinds of Magnets - Jam Handy, 1960.
2. Magnets Help to Find Direction - Jam Handy, 1960.
3. Magnets Can Attract Through Objects - Jam Handy, 1960.
4. Working With Magnets - Eye Gate, 1959.

Clouds Above and Water Below

Objectives

1. To become aware of the water cycle and comprehend its perpetuality.

2. To differentiate between cloud formations and understand their meanings concerning weather prediction.

3. To promote scientific thinking.

Concepts

1. Water is continually with us, but in differing states.

2. Water evaporates into the air; evaporation is effected by wind, temperature and the amount of water surface exposed to the air.

3. Precipitation occurs when the evaporated water vapor condenses on cool dust particles and the tiny droplets merge; the heavy drops fall to the earth. Precipitation takes several forms.

Motivation:

Question: Have you ever wondered why it rains and snows? In this unit we are going to find out.

Bulletin Board

Display pictures of various forms of precipitation and below them the word "WHY?"

WATER IS CONTINUALLY WITH US, BUT IN DIFFERING STATES. (FORMS)

Water can appear in liquid form.

A. Establish that water is visible in its liquid state by pouring water from one container to another. Establish also that water is transparent by placing an object at the bottom of a bucket of water.

B. Review and discuss uses of water in its liquid state.

Water can appear in vapor form.

C. Demonstrate water vapor (tiny droplets of water) by boiling water and observing steam. A vaporizer may also be used. What is another name for water vapor? (steam) Where have they seen water vapor before? Radiator, out of cooking foods, fog, clouds.

Establish how water vapor may be used.

Water can appear in the form of a gas.

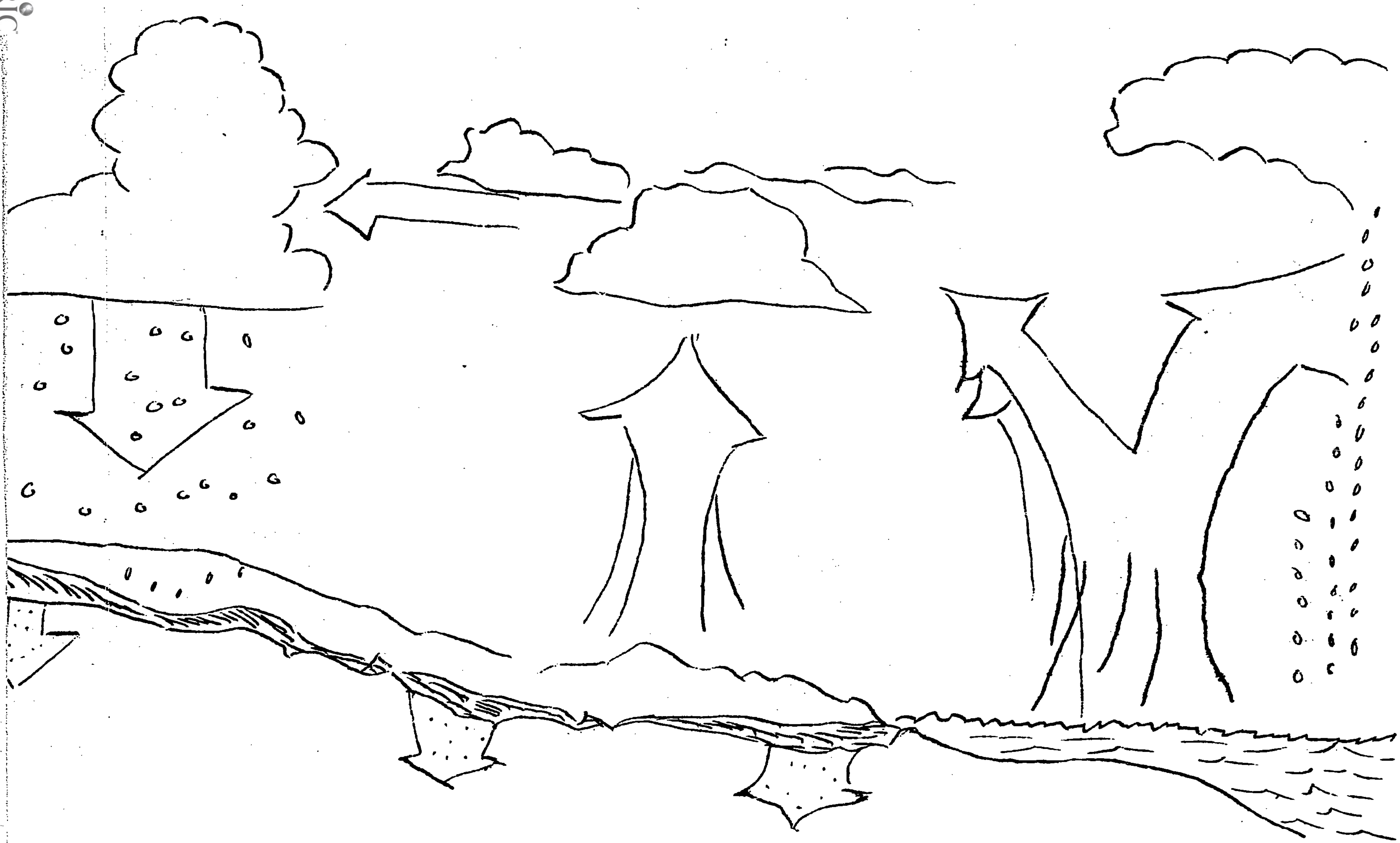
D. This can be shown through the principle of evaporation. Ask what happens to the puddles after a rain storm. (they disappear.)

Bring out that this is evaporation. What happens to the early morning dew?

The Water Cycle

When precipitation ensues water soaks into the ground. When the ground is soaked it begins to flow downhill through soil and rocks until it reaches bedrock. It may flow along bedrock until it reaches an open place. Some water keeps flowing until it reaches the sea. Water which doesn't flow down evaporates.

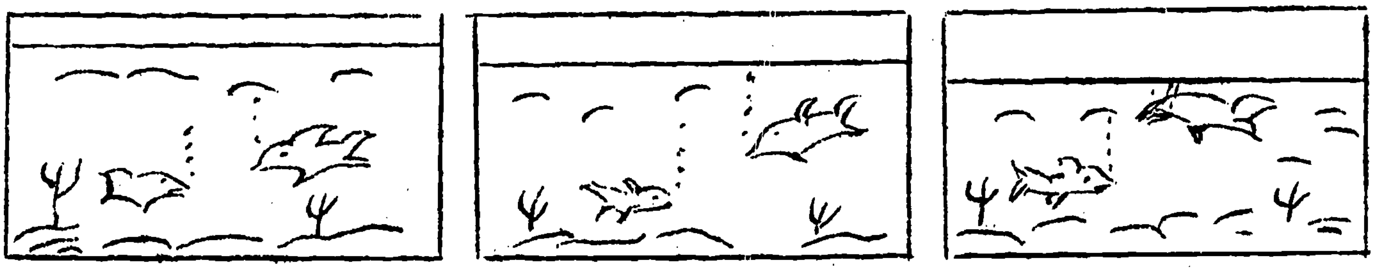
The water of the earth is always changing. The liquid water evaporates to form water vapor. Water vapor condenses to form liquid water again. The changes of the water on the earth from liquid to water vapor and back to liquid again is called the water cycle.



Simplified illustration of the water cycle

WATER EVAPORATES INTO THE AIR; EVAPORATION IS EFFECTED BY WIND, TEMPERATURE AND THE AMOUNT OF WATER SURFACE EXPOSED TO THE AIR.

A. An instance where evaporation takes place may be shown with these three sketches of an aquarium. Tell the class that a few weeks time had elapsed between each sketch.



A B C

Ask pertinent questions. Where is the water going in sketches B and C?

B. Materials: two glasses, (cover for one), water, sunny warm place

Procedure: Put three inches of water in each of two glasses in a sunny, warm place. Cover one glass. Measure the water in each glass every day. Keep a record of the findings.

Conclusion: Water evaporates into the air. The covered glass prevented noticeable evaporation.

Cite instances in which evaporation could be helpful. Could it be troublesome?

C. Materials: electric fan, pan of water, two identical handkerchiefs, string, hot plate or sunlight

Procedure: The two identical handkerchiefs may be soaked in water and wrung out with equal force. One should be placed on a line over a hot plate, or in the sun. The second handkerchief could be placed on the same line but should be away from the hot plate or in the shade. Which handkerchief dried first?

The same basic procedure will do for testing the effect of wind. Substitute the effect of a fan (wind) on drying the two identical handkerchiefs.

How might humidity effect evaporation? (Humidity - amount of water in the air.) What are foggy days like?

When there is much water in the air, how will clothes drying be effected? *Ask mothers.

Conclusion: Heat, wind and humidity are three factors effecting evaporation. Heat and wind speeds evaporation. A low humidity aids evaporation.

D. Materials: a cake or pie tin, two drinking glasses, water

Procedure: Put equal amounts of water into a glass and a cake or pie tin. (Allow students to determine controls.) Have children examine results the next day. Emphasize any disagreement as to which bowl contains the least water. Guide them to see that a precise comparison can be made by carefully pouring the remaining water into two identical glasses.

Conclusion: A larger surface area increases evaporation.
* Why does an opened, spread-out bathing suit dry faster than one crumpled into a ball?
* Why do people sweep out water puddles over a larger area?

Subconcept - Air contains moisture which condenses when it cools.

A. Materials: spoon, sugar, ink, 2 identical tin cans, ice cubes, container of water at room temperature.

Procedure: Encourage children to recall what happens to a pitcher filled with cold water or lemonade on a hot day. Have them recall that sometimes the containers holding these liquids feel wet. This usually happens when the container is cool. Does it have to be cool?

You can test with two cans of water, one with and one without ice cubes. Shortly, a beaded film of water should appear all over the cooler can.

Where does the water come from? Is it from inside or outside the can? Test for a leaking can.

1. add sugar to ice water.
2. add ink to ice water.

Conclusion: Water appears to be coming from the air surrounding the cooled container. Bring out that this event is condensation, the opposite of evaporation.

B. Cite instances in which condensation was noticed by children, such as the following:

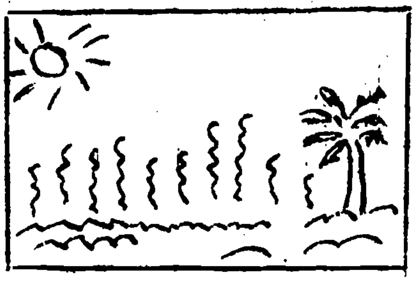
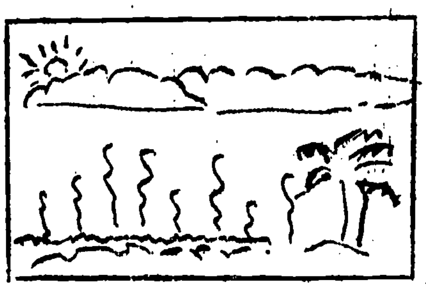
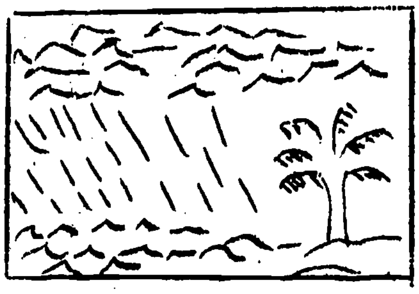
1. During shower or bath, water condenses on cooler mirror and walls.

2. Condensation on windows (warm air on cold windows.)

3. Water in the air condenses on cold water pipes in a basement.

Subconcept -
Water condensed in the air form clouds.

C. Materials: The pictures below or facsimile

A B C

Procedure: Exhibit the sketches. Bring out the warm sun is evaporating water from the ocean in sketch A. With water evaporating from the earth all the time, why doesn't everything dry up?

Develop that in sketch B the water vapor has risen far away from the warm earth. As the vapor rises higher it gets colder. The vapor condenses on tiny bits of dust and clouds are formed. More and more moisture collects and many tiny water droplets come together and become larger. In sketch C the larger drops fall as rain.

What happens after the rain? Point out that the "water cycle" is continuous. The same water is used over and over again.

D. Materials: several eye droppers, several glasses of water, a small piece of waxed paper and a tooth pick for each of the pupils.

Procedure: Distribute the waxed paper and toothpicks among pairs of pupils. Allow children to use eye droppers to place four water drops on each piece of waxed paper, an inch apart.

Let the children take turns pushing the water drops around the paper. They will discover that when several water drops are close together they suddenly fuse and become a larger drop. Emphasize that in a cloud, the water drops are much smaller. They move around because of air movements in the clouds.

PRECIPITATION OCCURS WHEN THE EVAPORATED WATER VAPOR CONDENSES ON COOL DUST PARTICLES AND THE TINY DROPLETS MERGE; THE HEAVY DROPS FALL TO THE EARTH. PRECIPITATION TAKES SEVERAL FORMS.

A. Materials: teakettle containing about an inch of water, hot plate, tray or can of ice cubes; sketches a, b, and c used previously

Procedure: From sketches, draw out that three things were needed for rain to occur: water, a source of heat to evaporate the water, and dust particles on which the cooling water could condense.

Ask how the above materials could be used to "make" rain. Draw out:

1. tea kettle could be used for water.
2. hot plate will help water to evaporate.
3. cold tray will help evaporated water condense.

Set teakettle on hot plate. When it begins emitting visible water vapor, place the cold tray in the "cloud." Water vapor will condense into large water drops and fall as "rain."

Review this analogy to assist understanding of actual process.

B. Discuss the various forms of precipitation, and the preparation which must be made and precautions that must be taken for each type.

1. rain
2. snow
3. hail
4. sleet

*Pictures might facilitate discussion.
*Children might role play their experiences with precipitation.

C. Rain can be made by placing a cool lid on a warm, moist terrarium.

CLOUDS TAKE VARIOUS FORMS. WE CAN OFTEN DETERMINE THE TYPE OF PRECIPITATION WHICH WILL ENSUE.

A. Have pictures on display of these cloud types: fog, cumulus, thunderheads, nimbus, cirrus and stratus.

Allow children to recall weather conditions which usually accompany each type of cloud.

<u>cumulus</u> - means "heap" - good weather
<u>thunderhead</u> - thunderstorms
<u>nimbus</u> - means "rainstorm" - rain (usually close to the ground.)
cirrus - means "curl" - made of ice - fair weather
stratus - means "layer" - rain is coming
fog - a cloud touching the ground

B. Make a chart showing a picture of each type of cloud and its "meaning."

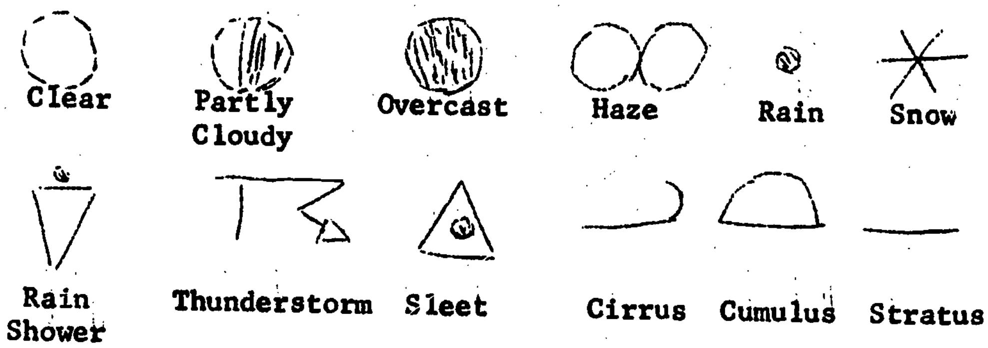
C. Children should be introduced to how other types of precipitation are formed.

<u>snow</u> - Formed when parts of a cloud become very cold.
<u>sleet</u> - Formed as raindrops fall through very cold air and freeze. Sleet is frozen rain.
<u>hail</u> - Pieces of ice are blown into the clouds where water forms on each piece. The piece of ice may then fall through cold air and turn to ice. (This process may happen many times before the ball of ice falls to earth.)

* If hail can be obtained, allow children to split the hailstones to see the "growth rings."

Culminating Activity

Keep a weather calendar by using the following symbols.



BIBLIOGRAPHY

* Adler, Irving and Ruth, Rivers, New York, John Day Co., Inc., 1962.

* Antoine, Tes, Wonders of the Weather, Dodd, 1962.

* Blough, Glen O. Not Only For Ducks: The Story of Rain, New York, McGraw Hill Book Co., 1954.

* Bonsall, George, How and Why Book of Weather, Grosset, 1960

Cantzlaar, George L., Your Guide to the Weather, Barnes and Noble, 1964.

Conway, H. McKinley, Jr. ed. Weather Handbook, Conway, 1963.

* Feravolo, Rocco V., Junior Science Book of Weather Experiments, Garrad, 1963.

Forrester, Frank, 1001 Questions Answered About the Weather, Dodd, 1957.

Gega, Peter C., Science in Elementary Education, John Wiley and Sons, Inc., 1966.

Jacobson, Lauby - Konicek, Learning in Science, 3, American Book Co., 1965.

* Larrick, Nancy, Rain, Hail, Sleet and Snow, Garrad, 1961.

MacCracken, Helen Dolmon, and others, Science Through Discovery-3, Syracuse, L.W.Singer Co.(Random House,Inc.) 1957.

* McGrath, Thomas, About Clouds, Chicago, Melmont Pub., Inc., 1959.

* Podendorf, Illa, The True Book of Weather Experiments, Children's Press, 1961.

Sutton, O.G. Understanding Weather, Pelican, 1960.

* Tresselt, Alvin R., Rain Drop Splash, New York, Lothrop, Lee and Shepard Co., Inc., 1946.

* Washburn, Stanley, Jr., Nimbo, the Little White Cloud, New York, Holt, Rinehard, and Winston, Inc. 1954.

* indicates children's books

Films

Our Weather	-	E B F
How Weather Helps Us	-	Coronet

Filmstrips

Weather	3 - 1 - B3
Weather Maps and Weather Forecasting	3 - 2 - A2
All Kinds of Weather	3 - 2 - A3
Water in Weather	3 - 3 - B6
Thunderstorms	3 - 3 - B7
Water and Its Importance	3 - 3 - D1
The World of Clouds	3 - 4 - C6

OUR PLANET: EARTH

Objectives

To become familiar with the earth's basic composition.

To become familiar with materials in the earth's crust and become aware of their qualities.

To realize that there are differences in soil quality and composition.

To promote scientific thinking.

Concepts

1. The earth is like a sphere, but flattened at the poles.
2. The earth is composed of three sections: the crust, the mantle, and the core.
3. The crust of the earth is composed of various materials.
4. Water, air, chemicals, and living things can cause weathering which changes rock.
5. Some minerals in rocks can be dissolved in water.
6. Undissolved minerals can be separated from water by filtering and/or evaporation.
7. Rocks rubbing against each other cause wearing away of rocks.
8. Sand, clay, gravel and rocks carried by water sink to the bottom when the movement of the water is slowed.
9. Topsoil is composed of mineral, vegetable and animal matter.
10. Earthworms help to keep soil moist.

THE EARTH IS LIKE A SPHERE, BUT FLATTENED AT THE POLES.

A. Create a scale model of the earth or, if not possible, display a globe.

    The earth is not a perfect sphere. It is slightly flattened at the poles. The distance through the center of the earth is about 25 miles more than from pole to pole. The thickness is about 8,000 miles.

    Allow children to determine the width of the earth by measuring with a string around the equator. Mark the distance on the string with a crayon,

Consult scale (25,000 miles.) Compare this distance with other trips made.

THE EARTH IS COMPOSED OF THREE SECTIONS: THE CRUST, MANTLE AND CORE.

A. Discuss the three layers of the earth.

1. outermost zone - crust - composed of solid rocks 20 - 30 miles deep.

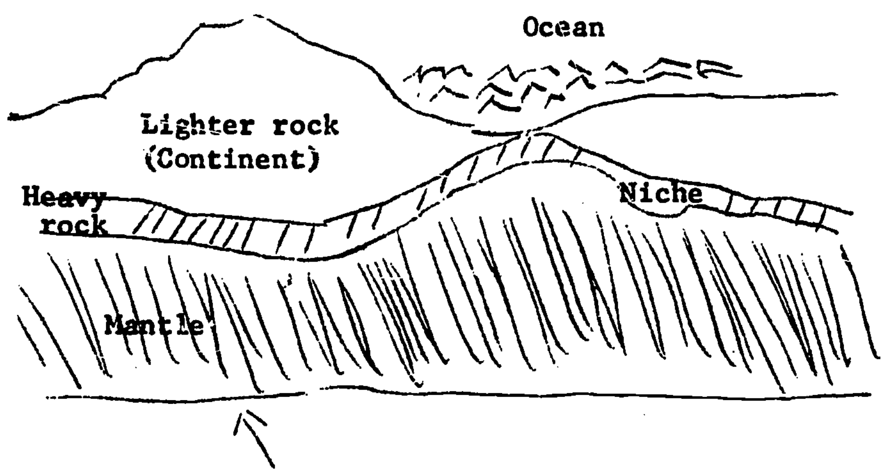
2. second zone - mantle - composed of solid rocks 1800 - 2000 miles.

3. inner zone - core - (two sections: (a) 1360 miles thick (b) 800 miles thick-thought to be liquid rock.)

B. Some pupils might make a model of the earth. Have them mount a 12-inch circular board on a base. Let them use plastic clay of different colors to represent the different materials of the earth. Have them place concentric rings of the different "materials" on the board. They can label the rings with flags of paper triangles attached to toothpicks.

C. Decide on a scale to draw concentric circles of the three layers of the earth.

D. Show an opaque projection of diagram below. Scientists want to drill through the earth's crust into the mantle - something never done before. Samples of mantle rock will provide needed information about how the earth was formed. Challenge pupils to select a place to drill. Impress upon students the enormous difficulty of drilling through a floating platform.



THE CRUST OF THE EARTH IS COMPOSED OF VARIOUS MATERIALS.

A. The crust of the earth is bedrock, which is covered in most places by loose materials such as rocks, sand, clay, and soil. Many different materials make up the earth's crust. The following are merely samples:

1. Shale	5. Granite
2. Pumice	6. Gypsum
3. Halite	7. Mica
4. Quartz	8. Sandstone

Rocks have varying characteristics

B. Students may work in pairs examining the above rocks. You might set up a worksheet as the following:

Shale: Color________________
Smooth or rough________________
Dull or shiny________________
Describe grains, if any__________

Other description________________

Rocks vary in hardness

C. Materials: six rock samples - not including shale and pumice, a nail

Procedure: Test each of the six samples for hardness by scratching with a nail.

Record: Things which can be scratched__________

Things which cannot be scratched__________

Which group is harder?________________

A harder material can scratch a softer material. List samples in their order of hardness.

Softest	1. (gypsum)
	2. (mica)
	3. (halite)
	4. (sandstone)
	5. (granite)
Hardest	6. (milky quartz)

WATER, AIR CHEMICALS AND LIVING THINGS CAN CAUSE WEATHERING WHICH CHANGES ROCK.

A. Discuss evidences of weathering which they have seen.

Ex. 1. A plant's roots may split a rock.

2. The freezing and thawing of water in a rock will split a rock.

3. Color changes due to continuous exposure to weather elements.

B. <u>Materials</u>: lava which has several large holes, water, rapid-sprouting small seeds (radish, clover) plastic bag

<u>Procedure</u>: Soak a piece of lava for several hours. Push rapid-sprouting small seeds into the holes. Place the lava in a plastic bag or small covered container. Add ½ teaspoon of water. Tie bag or cover container. The seeds will usually sprout and in some cases the roots will penetrate the rock. It is unlikely that the seedlings can be maintained for long, since the rock samples do not contain soil.

C. <u>Materials</u>: lava, shale, water, plastic bag, freezer

<u>Procedure</u>: Students who have a freezer available can take samples of lava and shale home. The rock should be soaked thoroughly and placed in a plastic bag to keep it from drying out. A number of successive freezings and thawings will be needed. (Possibility of the shale splitting along the layer lines and the lava crumbling.)

SOME MINERALS IN ROCKS CAN BE DISSOLVED IN WATER.

A. <u>Materials</u>: labels, pencils, test cups, storage racks, wash container, dropper, stir stick

<u>Procedure</u>: Students may be grouped into sixes. Each person will test one sample for its solubility by placing water in a cup with the sample and stirring. Samples should be left overnight.
A chart can be devised by each group with the results.

Conclusion: Halite - soluable
Gypsum - slightly soluable
Others - not soluable in water

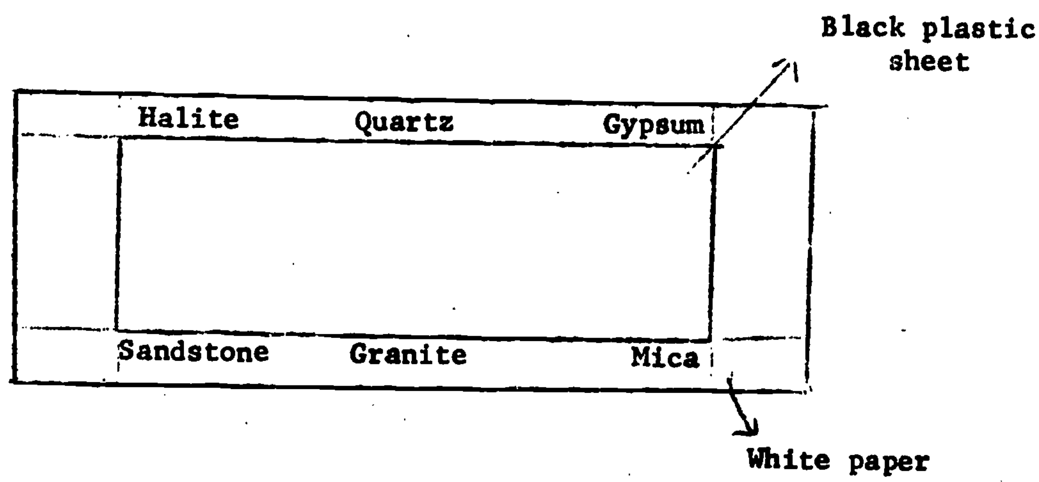
UNDISSOLVED MINERALS CAN BE SEPARATED FROM WATER BY FILTERING AND/OR EVAPORATION.

A. Materials: filter paper, plastic test cups, water

Procedure: Each student folds his filter paper in half and then in half again. Form a cone by opening one thickness of the folded paper, while the other three remain together. Clip the three thicknesses of the cone to the empty test cup, being careful to keep the open end of the cone level. The student then pours the contents of the solutions from preceding activity into the filter paper cone. Observe what happens to sample. What remains in the filter of each sample?
One student from each group folds another filter paper and clips it to a clean cup. He pours water from a wash container into filter paper until test cup is about ½ full. What happens as the water is poured into filter paper? Record results.

B. Materials: dropper, previous filtrates, white paper, black plastic sheet, water

Procedure: Each group prepares a sheet of white paper and a black plastic sheet as shown .



Place in classroom where paper can remain overnight undisturbed. Each student carefully removes the filter paper and solids it contains from his test cup. Place filter paper in a work tray to dry. When dry, the samples are stored in the group's plastic bag. Each student puts three drops of the filtrate from his sample on the group's black plastic sheet. Dropper must be thoroughly rinsed before each use. Tap water should be placed in the middle of plastic sheet.

C. <u>Materials</u>: filtrates previously made

<u>Procedure</u>: One test cup of each filtrate can be left uncovered and water allowed to evaporate (several days). Good size crystals will form from halite and gypsum filtrates.

D. Examine dry spots on black plastic sheet with magnifying lens. Observations to be made:

1. When water evaporated, tiny crystals of halite remained which resembled the original in shape and color.

2. The spot where gypsum filtrate was placed shows more residue than any other spot except by the halite filtrate.

3. The other four spots look similar. (Any deposit left when tap water evaporates is a mineral that was present in the water when it was drawn from the tap.)

* Discuss the importance of filtering and evaporating tap water as a control.

ROCKS RUBBING AGAINST EACH OTHER CAUSE WEARING AWAY OF THE ROCKS.

<u>The rate at which rocks are worn away depends in part on the kind of rock. Hard rocks are worn away more slowly than softer rocks</u>.

A. Discuss instances where students have observed running water carrying solid materials.

1. streams or rivers

2. mountain streams

B. Materials: stream or river water sample, filter paper, cup, black plastic sheet.

Procedure: Filter water sample and examine material on filter paper. Evaporate some of the filtrate as drops on a black sheet of plastic. Some of filtrate can be left to evaporate in a test cup.

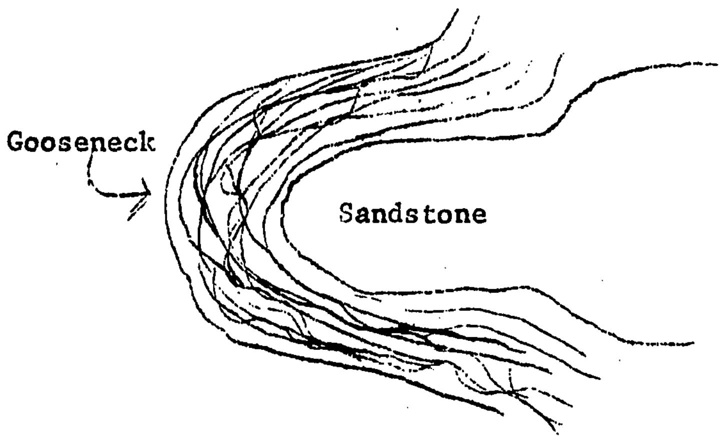
Conclusion: Solids are present in the water sample.

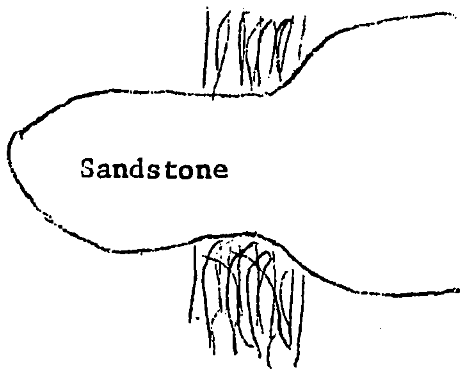
C. Materials: two rocks of the same type for every two students, black plastic sheet for every two students.

Procedure: The students take turns rubbing two samples of the same material together for two minutes over a black plastic sheet. They gather all the crumbled or powdered material into one pile and place the pile in one corner of a piece of paper. They write the name of the material next to the pile. Allow the students to compare the powdered material from other rocks as done by the rest of the class. Record results.

Conclusion: Some rocks wear away quicker than other rocks. Quartz showed the least effect.

Background: Natural bridges are created by the erosive action of a stream. (Ex. Rainbow Bridge - Southeast Utah - 280 ft. in length, rises 309 ft.) The bridge is formed of sandstone which is harder than rock, which originally surrounded it. At one time, Bridge Creek formed a gooseneck around the harder sandstone. As the creek eroded, the surrounding rock, it finally reached a level of softer rock below the hard sandstone. The softer rock wore away and the creek then followed a straight course under the sandstone arch. Floods carrying rocks and boulders downstream chipped away the sandstone, making a thinner and more graceful bridge. The exposed sandstone was also affected by weathering which caused further refining of the shape.





D. Allow each student to examine the abraded area of each sample with a magnifying lens. Record observations.

Gypsum	Shiny surface became dull and scratched.
Granite	No change.
Mica	Pieces flecked off.
Sandstone	Became more rounded
Milky Quartz	No change.
Halite	Shiny surface became dull and scratched.

E. Materials: rock rubbings, magnifying lenses, lava samples

Procedure: Examine grains with magnifying lenses. Guiding questions may be:

1. Which samples do you think might become clay? Why? (Pumice, because pieces that rub off are soft, powdery and fine like clay.)

2. Which samples do you think might become sand? Why? (Sandstone, milky quartz and granite because pieces that rub off are hard, rough, and coarse like sand.)

3. Which samples do you think probably would not become clay or sand? Why? (Halite and gypsum because these are soluble in water and probably would dissolve, except in a desert.)

SAND, CLAY, GRAVEL AND ROCKS CARRIED BY WATER SINK TO THE BOTTOM WHEN THE MOVEMENT OF THE WATER IS SLOWED.

The rate at which the particles sink depends upon their actual size and weight.

A. Materials: clay, sand, gravel, test cups and covers, spoons

Procedure: Put two spoonfuls of sand, two spoonfuls of gravel, and two spoonfuls of clay in a test cup. Fill the test cup with water halfway to the top. Cover cup and shake thoroughly. Watch what happens. Which settles first, second and third. Repeat two more times and record results.

First Trial	Second Trial	Third Trial
1. Gravel and sand	Gravel and sand	Gravel
2.		Sand
3. Clay	Clay	Clay

Save mixtures

B. <u>Materials</u>: mixtures from last activity, large container of tap water and one of salt water

<u>Procedure</u>: Each student shakes the contents of his test cup thoroughly and pours it into one of mixing containers (tap water or salt water). Each student observes what happens when he pours the contents of his cup into one of the mixing containers and what happens when his partner pours his into the other. Record both observations.

<u>Conclusions</u>: <u>Mixture in tap water</u>: (Gravel and sand settle to the bottom very quickly. Clay clouds the water uniformly.)

<u>Mixture in salt water</u>: (Gravel and sand settle to the bottom very quickly. Clay clouds the water but the particles seem to come together and the cloudiness is <u>not</u> even.

Allow mixtures to stand for ½ hour.

Observe mixtures. Salt water looks clearer than the tap water. More clay has settled out of the salt water, than out of the tap water.

<u>The presence of dissolved materials (salt) in the water may affect the rate and the end product of sedimentation.</u>

C. <u>Materials</u>: six test cups, six filters, labels, black plastic sheets, droppers, mixing containers from last activity.

<u>Procedure</u>: Label three test cups "Tap Water" and three test cups "Salt Water." Prepare six filter papers and clip one to each of the test cups. Place two cups with different labels on each of three work trays. Pour off most of the liquid from the top of each of the mixing containers. Stir the remaining contents of the mixing containers thoroughly and pour about ½ a test cupful into each of the filters. When liquid has filtered through, remove the filter papers. Spread filter papers on two trays, one marked "Salt Water Sediment" and the other marked "Tap Water Sediment."

Allow sediments to dry.

In the meantime, allow students to place three drops of filtrate from each mixture onto a black plastic sheet and label. Each student should examine the dried materials on each filter paper. Record observations. Compare spots on black plastic sheet (magnifying lens).

Conclusion: The residue from the salt water seemed firmer and somewhat more cemented together.

D. Examine shale. Note texture of grains and its composition. Shale was probably formed from a sediment of clay.

TOPSOIL IS COMPOSED OF MINERAL, VEGETABLE AND ANIMAL MATTER; CONSERVATION BENEFITS EVERYONE.

Topsoil is composed of a thin layer of mineral, animal and vegetable matter; soil differences result from differences in these materials.

A. Materials: soil, newspaper, old spoons or sticks

Procedure: Allow three to four pupils to work together in examining soil on newspaper. Allow them to pick apart the soil. Have students separate matter found into the three categories: animal, vegetable and mineral. Items found might be listed.
Develop term humus (decaying vegetable and animal matter).

* B. Discuss: Are we likely to find much humus in the desert?

* C. Discuss: What, if anything, do earthworms do to the soil? (They burrow into the soil and make holes. This loosens the soil and more air circulates. The humus they eat passes through their bodies and helps to fertilize the soil. They become part of the humus when they die.)

D. Materials: two jars with screw caps, one half filled with rich topsoil, the other with poor subsoil, container of water

Procedure: Inquire as to why we don't see plants growing in subsoil while we do in the topsoil. Ease of planting seeds in topsoil is (the most likely response.

Have children examine the two types of soil. Draw out that the subsoil appears to lack much humus

You can test this by pouring water to within several inches to the top of both jars. Shake jars to separate humus from rock particles. Leave until material settles; may take several hours. (Because humus is lighter than rock particles, it will separate and rise to the top.)

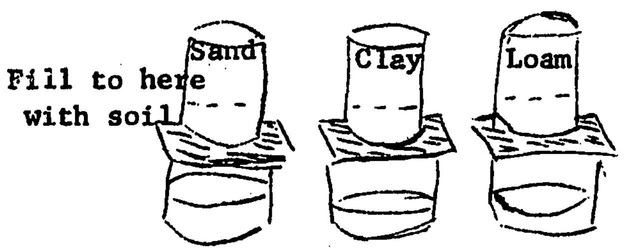
Conclusion: Topsoil has much more humus than subsoil. The soil increases in coarseness toward the jar bottom.

Help children identify the materials in the soil from the bottom of the jar up: pebbles, sand, silt, clay, humus.

E. Establish that topsoils differ in composition with amounts of sand, silt, clay and humus varying.

Allow children to examine different kinds of topsoil. Help children to describe the different qualities of each soil type (sandy, silty, clayey or loamy.)

* F. Materials: three identical tin cans open at both ends, dried equal amounts of sand, clay and loam soil, three small pieces of fine mesh wire screen, six pencils, three glass bowls, container of water.



Carefully pour an equal amount of water into each can. The water will run fastest through the sandy soil, then the loam and slowest through the clay.

Pose the problem of the woman who planted three healthy identical plants - one in each present soil type. She gave each the same amount of fertilizer and water daily. After a short while, the plants in the clay and sand soil died. Why? What do you think the roots look like?

Conclusion: The fine clay particles help to hold soil together, but clay alone retains too much moisture. Large sand particles are good for drainage, but too much drainage results in too scant a water supply for most plants. A mixture of these materials usually works best.

EARTHWORMS HELP TO KEEP SOIL MOIST.

Earthworms help to aerate the soil. They help to conserve water in the soil. Earthworms are active in the dark and avoid the light.
Earthworms dig their way through the soil and thereby mix rich, decaying organic material throughout it.

A. Materials: three coffee cans, rich loamy soil, earthworms, sawdust, corn meal

Procedure: Fill each coffee can 2/3 full of loamy soil. To two of the cans add some earthworms. To each can add about an inch of sawdust and ½ inch of corn meal.

How do earthworms react to the light?

Place one of the cans with worms near a window. Have a lamp near it which can be turned on at night. Place the other two cans in the dark. Add small amount of water each day.
Observe each day and make notes. (The soil in the can kept in the dark appears to have been turned over more by the worms.)

Much of the water would be trapped in the loosely dug tunnels of soil the worm makes; therefore, the water will not evaporate as quickly.

FILMS

What is Soil?	- Encyclopedia Britannica Films
Your Friend, The Soil	" " "
Treasures of The Earth	- Churchill Films

FILMSTRIPS

About Our Earth	3 - 1 - Af
The Earth - A Great Storehouse	3 - 2 C1
Soil Resources	3 - 3 - A2
Soil and Its Uses	3 - 3 - D3
Water and Soil	3 - 5 - A2

BIBLIOGRAPHY AND REFERENCES

* Adler, Irving and Ruth. The Earth's Crust. New York: John Day Co., Inc., 1963.

American Geological Institute. Geology and Earth Science Source Book. New York: Holt, Rinehart and Winston, Inc., 1962.

* Clemons, Elizabeth. Rocks and The World Around You. New York: Coward McCann, Inc., 1960.

Fenton, Carol Lane and Mildred A. Riches From The Earth. New York: John Day Co., Inc., 1953.

Gallant, Roy A. Exploring Under The Earth. New York: Garden City Books, 1960.

Gega, Peter C. Science in Elementary Education. New York: John Wiley & Sons, Inc., 1966.

* Irving, Robert. Rocks and Minerals and the Stories They Tell. New York: Alfred A. Knopf, Inc., 1956.

Jacobson-Lauby-Konicek. Any one of this series published by American Book Co., 1965.

* Jenson, David E. My Hobby is Collecting Rocks. Chicago: Children's Press, Inc., 1958.

* Layton, Aviva. The Singing Stones. New York: Abelard-Schuman, Ltd. 1963.

* Page, Low Williams. Rocks and Minerals. Chicago: Follett Publishing Co., 1962.

* Pearl, Richard M. Wonders of Rocks and Minerals. New York: Dodd, Mead and Co., 1961.

Pough, Frederic H. A Field Guide to Rocks and Minerals. Boston: Houghton-Mifflin Co., 1955.

Reinfeld, Fred. Treasures of the Earth. New York: Sterling Publishing Co., Inc., 1954.

Schneider, Herman and Nina. Science Far and Near - 3. Boston: D.C. Heath and Co., 1968.

Seaman, David. The Story of Rocks and Minerals. Irvington-on-Hudson: Harvey House, Inc., 1961.

Syrocki, B. John. What Is a Rock? Chicago: Benefic Press, 1959.

Tannenbaum, Harold E. and Others. Geologic Processes. New York: McGraw-Hill Book Co., 1967.

Wyckoff, Jerome. The Story of Geology. New York: Golden Press, Inc., 1960.

* Books recommended for children.

THE EARTH IN SPACE

Objectives

1. To comprehend the earth's relationship to other planets, the moon and the sun.

2. To comprehend the reasons behind some of our natural phenomena, i.e., night and day, seasonal change, the moon's changing appearance.

3. Promote scientific thinking.

Concepts

1. The solar system consists of the sun and all the objects that move around it.

2. Stars usually appear in the same position relative to each other.

3. Planets vary in size and orbit.

4. The earth is in constant rotation as it orbits the sun.

5. All planets receive heat from the sun.

6. The earth's motion in space causes time and seasonal changes.

7. The relative motions of the sun, earth and moon bring about moon phases and eclipses.

8. Man has devised many instruments to help him study the stars and the planets.

Motivating Ideas

1. Bring in pictures of the earth as taken from the proximity of the moon. Discuss. Why does the earth appear smaller than the moon when we know it is larger?

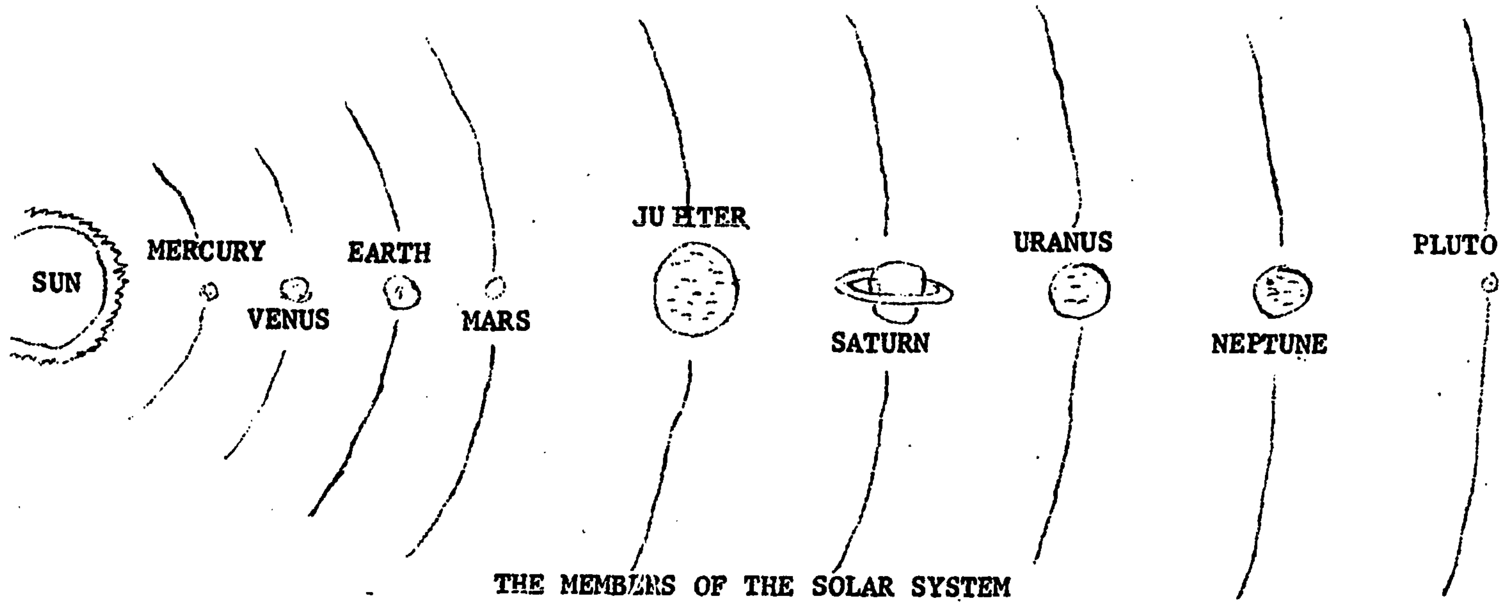
2. Create an introductory bulletin board showing the earth's relation to the rest of the solar system.

3. Show introductory filmstrip to the Solar System. Discuss beforehand. Where is the earth?

THE SOLAR SYSTEM CONSISTS OF THE SUN AND ALL THE OBJECTS THAT MOVE AROUND IT.

A. Show filmstrip "The Solar System" (3-2-E5). This will serve to refresh the concept of the solar system as the students were already introduced to it previously.

B. Create dioramas, charts and/or bulletin board to show the relationship of the planets to one another and the sun.
   - The planets are the largest bodies revolving around the sun.



THE MEMBERS OF THE SOLAR SYSTEM

STARS USUALLY APPEAR IN THE SAME POSITION RELATIVE TO EACH OTHER.

A. Materials: oatmeal box, nail, flashlight

Procedure: Punch holes in one end of box to represent the North Star (be sure it is in center) and the two dippers. Cut hole in the other end for insertion of flashlight. Project one wall and rotate. If desired, punch one or two holes near rim to represent stars not in dippers. Draw a line across projection surface. Have children note how star goes below line and rises above it again as box is rotated.

Conclusion: Children gain concept of constant position of North Star, the behavior of circumpolar stars and the manner in which stars "appear" to rise and set.

B. Materials: umbrella, gummed stars or paint, table

Procedure: Place North Star at center of umbrella; several circumpolar constellations around it and some stars near outer rim of umbrella. Place so that a portion of the umbrella is below table edge (horizon). Rotate.

Conclusion: Same as A.

C. Develop how the term "planet" was derived. Explain that thousands of years ago, no one knew about planets. People thought all such objects were stars. But these so called "stars" were a puzzle. They never seemed to stay in one place as the other stars did. Sometimes they would appear dim and far away; at other times near and bright. They seemed to "wander" through the sky.

Using a solar system model, determine under which conditions some planets would look nearer and farther away from the earth. (If the planets moved at different speeds some might get ahead or fall behind others. If they all moved at the same speed, each inside planet would move ahead of its outside partner.) Demonstrate.

PLANETS VARY IN SIZE AND ORBIT.

A. Materials: balloons, string, mobile base

Procedure: Make a solar system mobile using balloons. Label planets and the sun. Place in appropriate relation to one another. Show how the planets orbit the sun by orbiting one planet at a time. If possible, have all planets orbiting at once by assigning one child per planet.

Conclusion: Planets vary in size and orbit. They move simultaneously in a coordinated fashion.

B. Materials: large outdoor area; chalk, 20 ft. string

Procedure: Take the class to a suitable location out on the playground. It will save time if someone previously has drawn with chalk and 20 ft. string nine circles of proportionate sizes to represent planetary orbits. Proper scale may be ignored for now and developed later. Orbits 1 ft. to 2 feet apart should be satisfactory. Let the 9 planet children line up in a row.

First, test to see what happens to their distance from the planet earth child if they move counterclockwise at different speeds in orbit. After a few seconds, have pupils stop and notice the planets' changing distances from the earth. Now get them moving in orbit at the same speed. Each outer planet will fall behind its immediate inner planet.

C. In class discussion, speculate about the difference between a star and a planet, verify decisions by checking references.

* D. Making an Oatmeal Box Planetarium

Materials: oatmeal box, two diagrams to pose on box, sharp instrument to punch holes, paste, light bulb, extension cord.

Procedure: Cut out hemisphere diagrams and paste to an oatmeal box. Line up diagrams by guidelines of Big Dipper. Punch holes where stars and planets appear. Punch hole in box lid and insert electrical extension cord. Put bulb in socket and close lid. Plug in other end of cord to outlet. Lay planetarium on table with hemisphere up.

Darken room. The light bulb, through holes, will cast a simulated constellation on the ceiling.

THE EARTH IS IN CONSTANT ROTATION AS IT ORBITS THE SUN.

ALL PLANETS RECEIVE HEAT FROM THE SUN.

A. Materials: lamp with unshielded light bulb

Procedure: Point out that Mercury, the planet closest to the sun, may have a surface temperature of about 770° F. Pluto, the outermost planet, has a temperature estimated at 400° F. Why the difference? Develop discussion.

Turn on lamp. Have several children position their hands at various distances from it. Does it feel warmer when one's hand is close to the lamp? Colder when further away?

Conclusion: The closer one is to the heat source, the warmer one is.

B. Look up data such as planet temperature, distance from sun. Make a chart and/or graph findings.

Planet	Temp. (F)	Distance from Sun
Mercury	770°	
Venus	130	
Earth	55	
Mars	30	
Jupiter	-225	
Saturn	-250	
Uranus	-300	
Neptune	-350	
Pluto	-400	

Pupils will easily see relationship between the planets' distance from the sun and their respective temperatures.

THE EARTH'S MOTIONS IN SPACE CAUSE TIME AND SEASONAL CHANGES.

Time Changes

A. Materials: filmstrip projector, globe

Procedure: Review how the earth's rotation in sunlight causes night and day. This can be demonstrated with a filmstrip projector and a globe. Have the class recall that the sun appears to "rise" in the east and "set" in the west. Which direction is the globe rotating? Allow pupils to turn the globe with a filmstrip projector acting as the sun to establish which direction is correct. (Counterclockwise)

DAY AND NIGHT

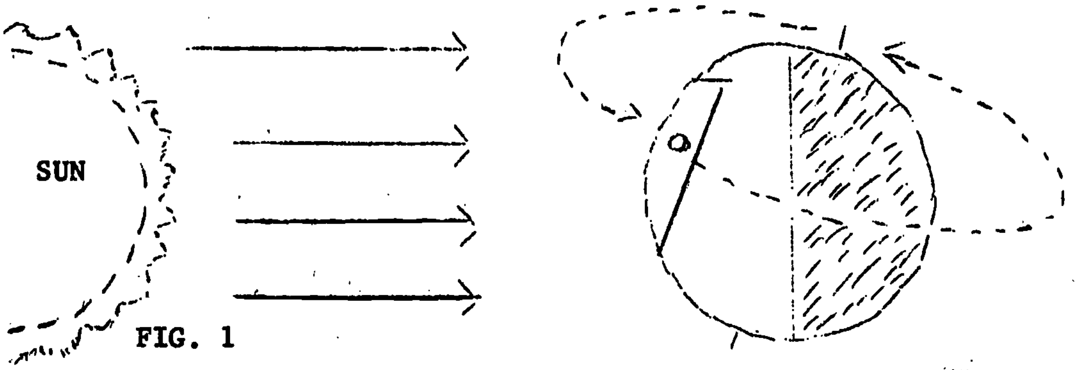


FIG. 1 NOON

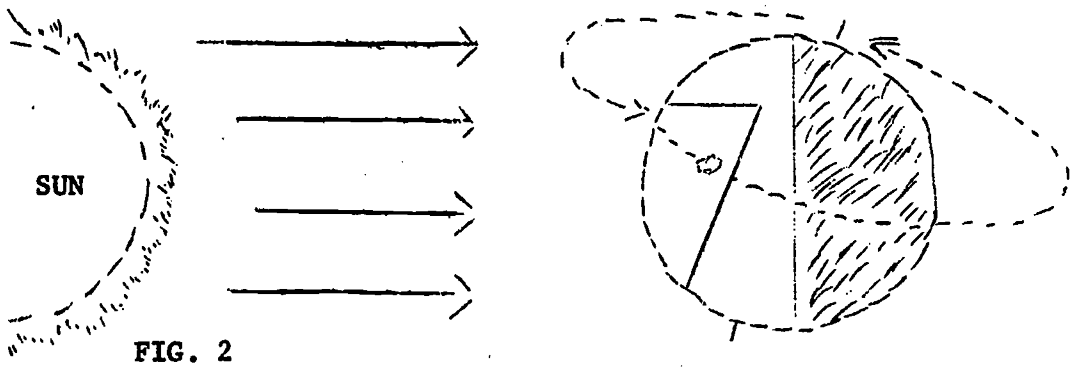


FIG. 2 AFTERNOON

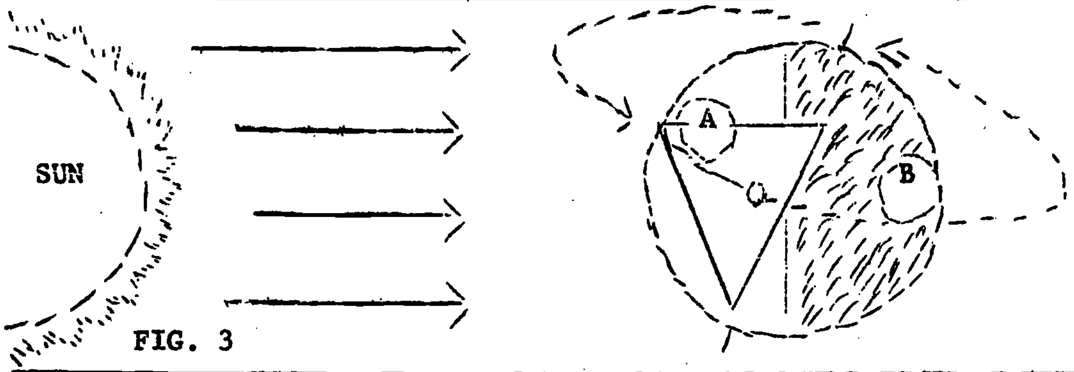


FIG. 3 SUNSET

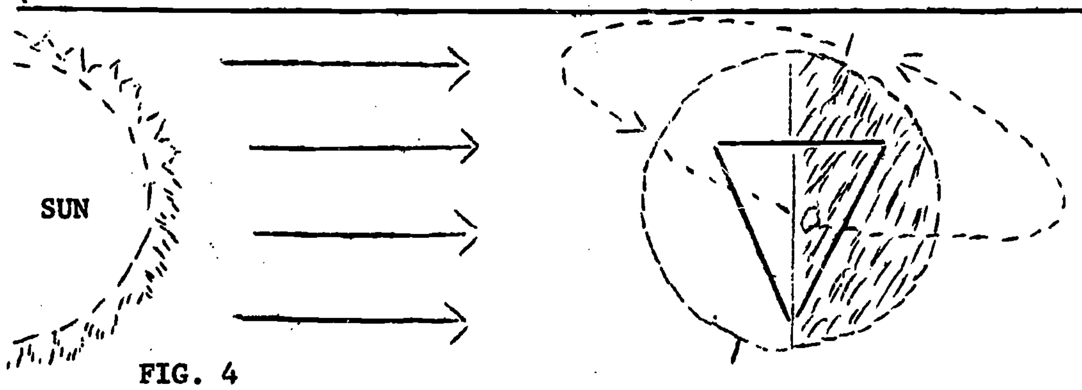


FIG. 4 EVENING

<u>Conclucion</u>: The earth rotates in a counterclockwise direction so that the sun appears to rise in the east and set in the west.

C. Materials: map of Continental U.S. with time zones shown, opaque projector

Procedure: Exhibit a sketch or opaque projection of a Continental U.S. map. How is the time problem solved in a country as large as ours? Draw out that the Continental United States is divided into 4 standard time zones. The people in each zone agree to set their watches and clocks to the same time, whether the sun is directly overhead or not. In this way, a watch needs only to be changed three times as one flies or drives from one coast to the other.

Latin terms ante meridien and post meridien may be introduced at this point. (Ante meridien A.M. before noon, post meridien P.M. after noon).

Seasonal Changes

D. Materials: projector or unshaded lamp, globe, string at least 2 ft.

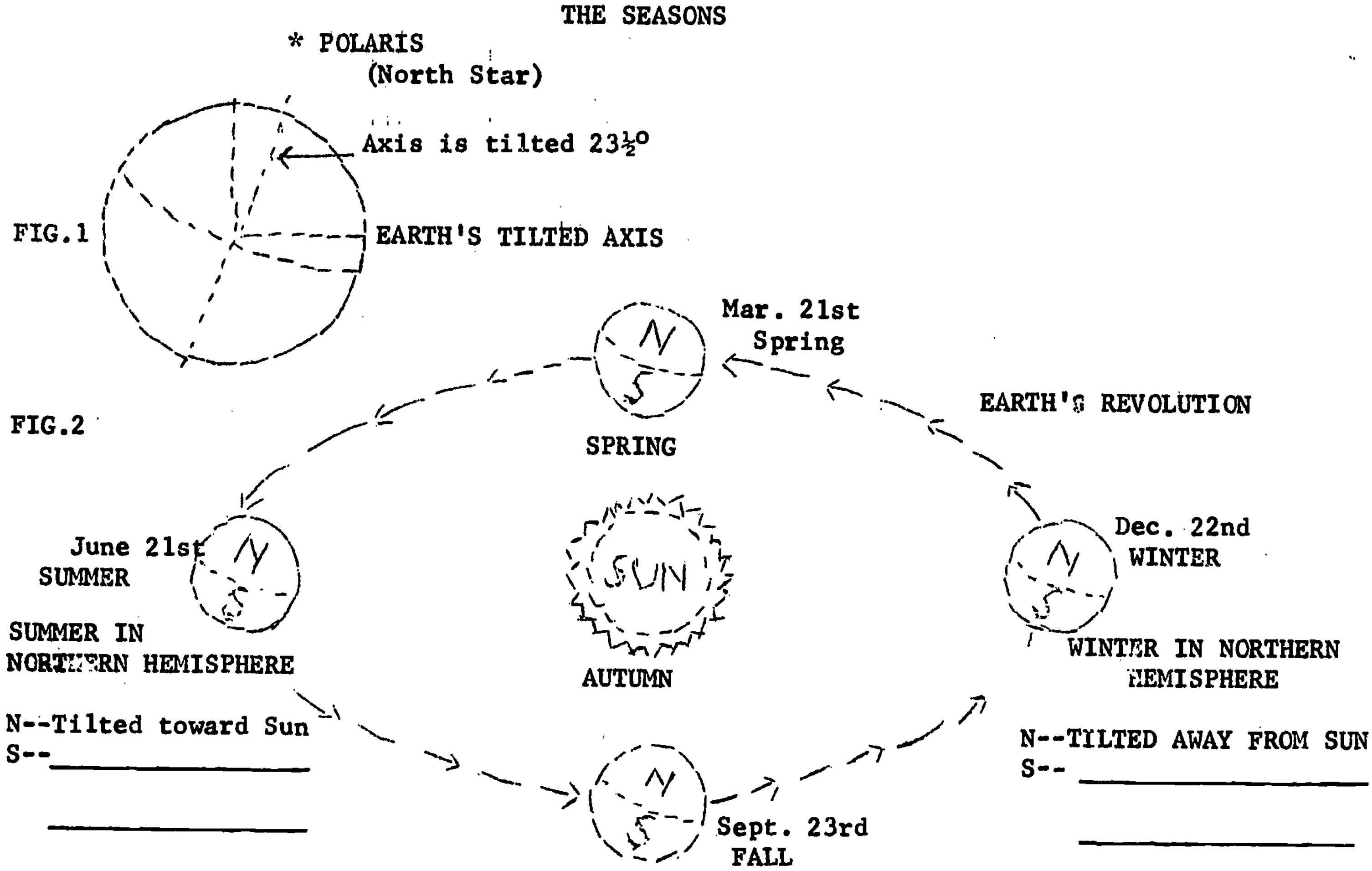
Procedure: Develop that, in addition to rotation, the earth also revolves about the sun. Take the classroom globe, and while rotating it slowly, move around a pupil who acts as the sun. Emphasize that the earth's tilted axis continues to point in one direction - toward the north star - throughout the revolution. The entire revolution takes about 365 days, or one year.

Pose a problem. On Dec. 22nd, New York City has about 9 hours of daylight and 15 hours of darkness. On June 21st it has the reverse. Why? Discuss briefly.

Darken the room. Turn on a slide projector or unshaded lamp. Place the globe in winter position shown. Fix a small lump of clay at the position of New York City, so that it may be easily observed. Slowly rotate the globe at a fairly uniform rate of speed. Is the location of New York City longer in darkness or night? (Measure with string.)

Do reverse by putting globe in June 21st position.

THE SEASONS



E. <u>Materials</u>: 2"-2" screen material, slide projector, globe, unlined paper, pencil

<u>Procedure</u>: Is summer warmer only because the days are longer? Winter colder only because the days are shorter? What might be another reason? Encourage conjecture based on the children's observations.

Hold up a pice of 2"-2" screen material. Place it in the slide projector slot. Shine and focus the projector on the globe positioned in the December location. A sharp grid effect will be seen. Ask what the pupils observe. (The squares become increasingly elongated toward the top and bottom portions of the globe.) Does this give a clue? (The sunlight is more at an angle than at the equator; it is spread out more, therefore, not as intense.)

Have someone place paper over the projected rectangle at New York City and trace it with a pencil. Will it be the same size at the June position? (Try it.) The June's rectangle should be appreciably less elongated.

Conclusion: In summer, sunlight is more nearly overhead and so is more intense.

* F. Is vertical sunlight warmer than slanted sunlight?

Materials: 2 identical thermometers and 2 small pieces of cardboard

Procedure: Lay one thermometer on one cardboard in a sunny place. Next to this, prop up the other cardboard and thermometer against a book so that sunlight hits it vertically. The cardboard pieces will insure similar background. A few minutes in strong sunshine should be enough for a significant difference to appear in thermometer readings.

Conclusion: Vertical sunlight is warmer than slanted sunlight.

THE RELATIVE MOTIONS OF THE SUN, EARTH AND MOON BRING ABOUT MOON PHASES AND ECLIPSES.

Moon phases appear when the moon revolves around the earth.

A. Materials: Chart or blackboard sketch of moon phases, slide projector, white volleyball

Procedure: Establish that the moon is the earth's closest neighbor in space. What makes the moon shine? Bring out the difference between a body that reflects light and one that generates light.

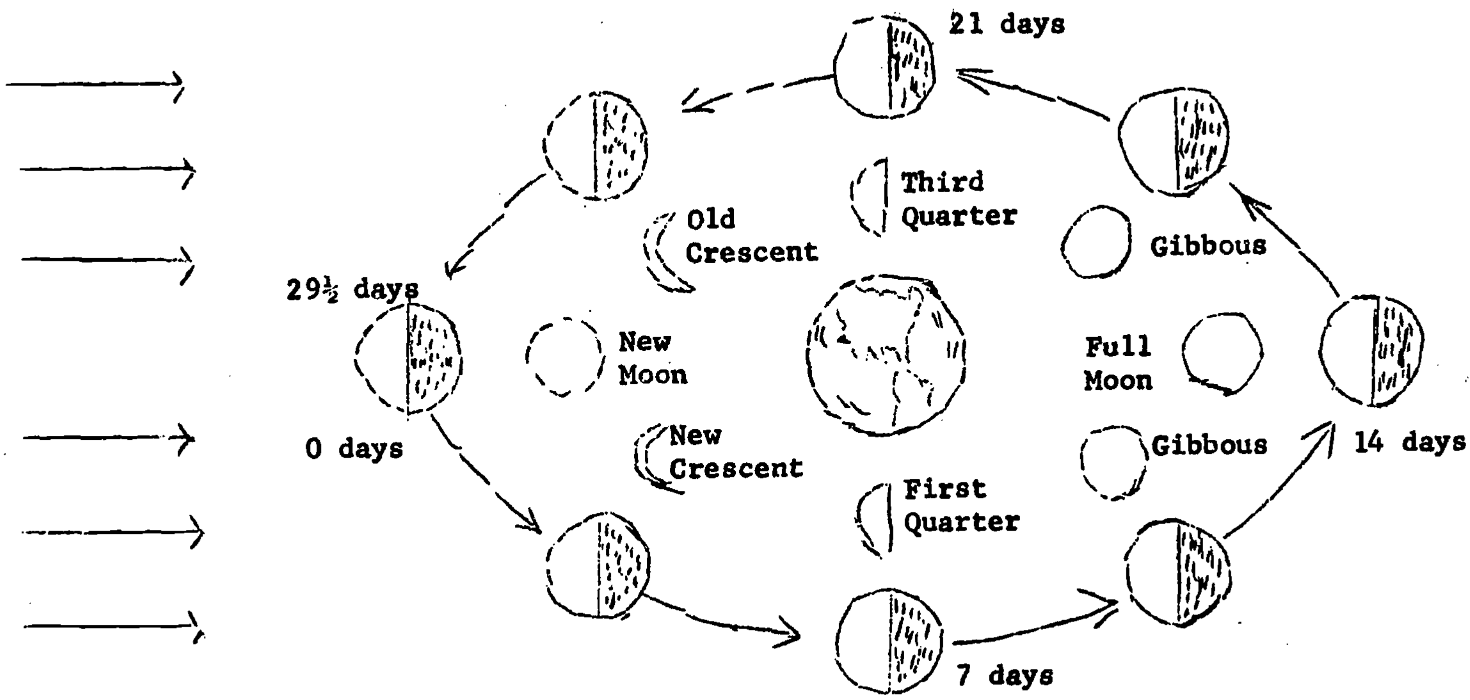
Does the moon always look the same? Have some children draw sketches on the chalkboard of moon shapes they have observed. Why does the moon seem to change its appearance?

Reveal a sketch of the moon phases. Bring out that the moon is shown in 8 different positions as it revolves around the earth. The entire revolution takes a little less than one month.

Darken the room and turn on slide projector. Have a child stand with a white volleyball at arm's length a little above his head. The child should be about 10 feet from the projected light.

Starting in position 1, let him put the "moon" through a full revolution as he rotates in place and observes the moon from his position. Other pupils observe from their seats. Does the moon keep changing shape? (The student rotating the moon should say "Yes" while his classmates say "No.") Discuss the discrepancy. Have other children rotate the moon. Bring out that everyone in the classroom is at varying relative positions.

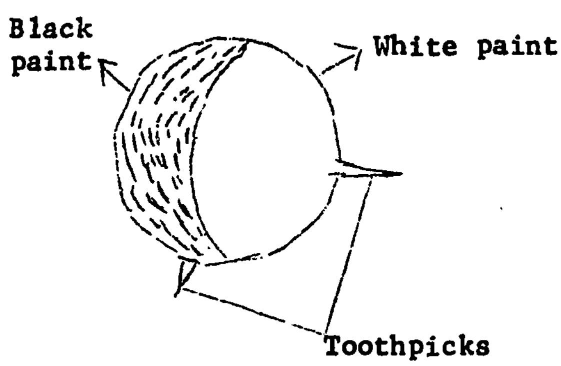
<u>Conclusion</u>: The moon appears to go through changes or <u>phases</u> as it is seen in different positions of its orbit around the earth.



THE MOON'S PHASES

B. Materials: one inch ball of clay for each child, two toothpicks per child, several small paint brushes, black and white tempra paint.

Procedure: Each child should shape clay into a ball, and paint one half white and the other half black. Guide them to insert toothpicks as shown.



The white half of the moon is receiving sunlight. Therefore, it must always face the sun. Designate one wall as the sun. The top toothpick will remind children to keep white part facing proper direction. The bottom toothpick will be used to hold the model.

Have class members stand and view their models at arms length in position 1. Caution all not to reveal what they see. Have them try all 8 positions several times.

Have each draw his observations on a sheet of paper. Assist where necessary.

Conclusion: Same as A.

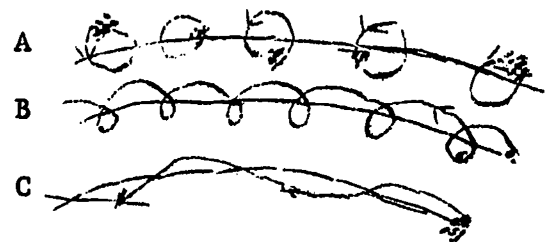
* C. The names of the phases may be introduced.

1. new moon	5. full moon
2. new crescent	6. old gibbous
3. first quarter	7. last quarter
4. new gibbous	8. old crescent

* Encourage pupils to sketch and label the moon's appearance each night at a designated time for 30 days.

* If the moon revolves, why is only one half visible to the earth while the other side remains unseen from the earth?

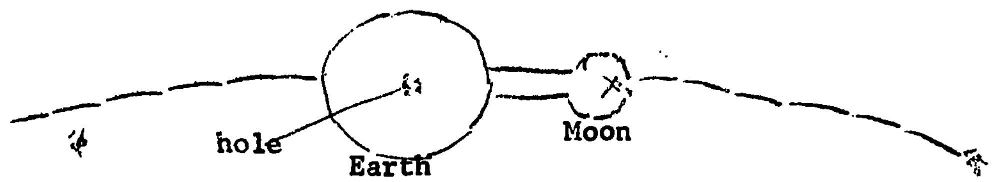
* Show a sketch of the diagram below.



The long arc in A, B, and C represents part of the earth's orbit. Since the earth is moving, which of these three patterns would show the true path of the moon?

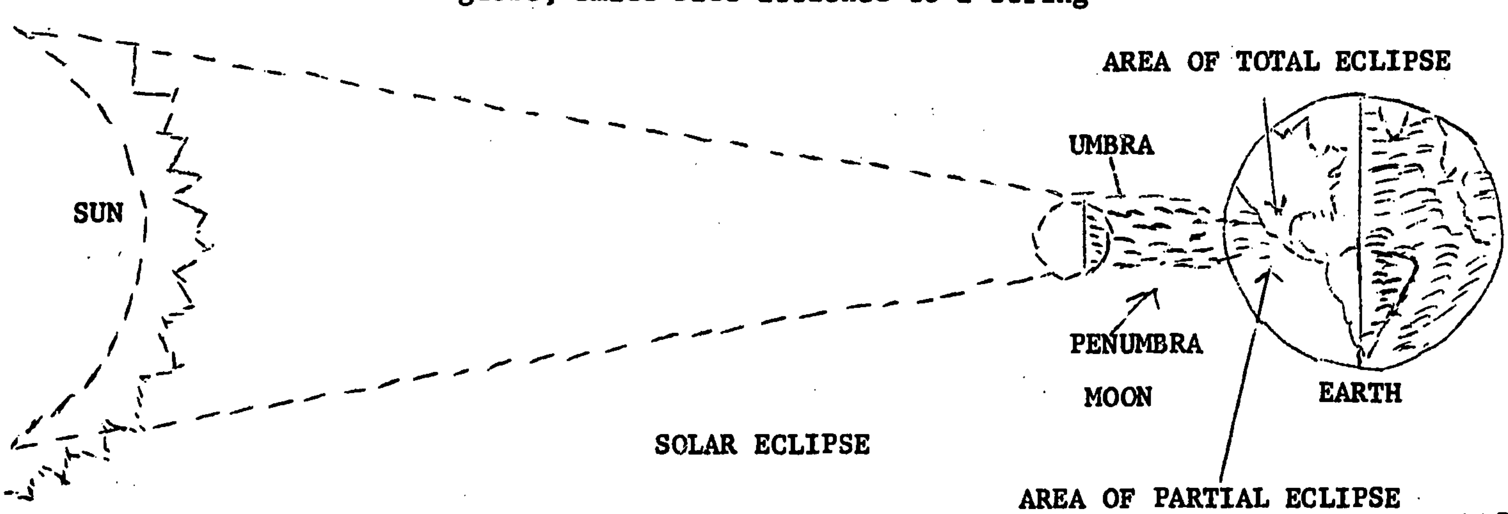
Allow children to discover for themselves. Each child will need the above materials. Give directions. Cut a rough earth-moon model from construction paper. Punch a hole in the earth's center with a pencil. Put an X near the far "end" of the moon. Draw a long arc on the writing paper. Align models on the drawn arch as shown, as far to the right as possible.

Have pupils move the earth slowly to the left and revolve the moon counterclockwise. A pencil mark can be made at the X periodically to trace the moon's track. A serpentine path will result.

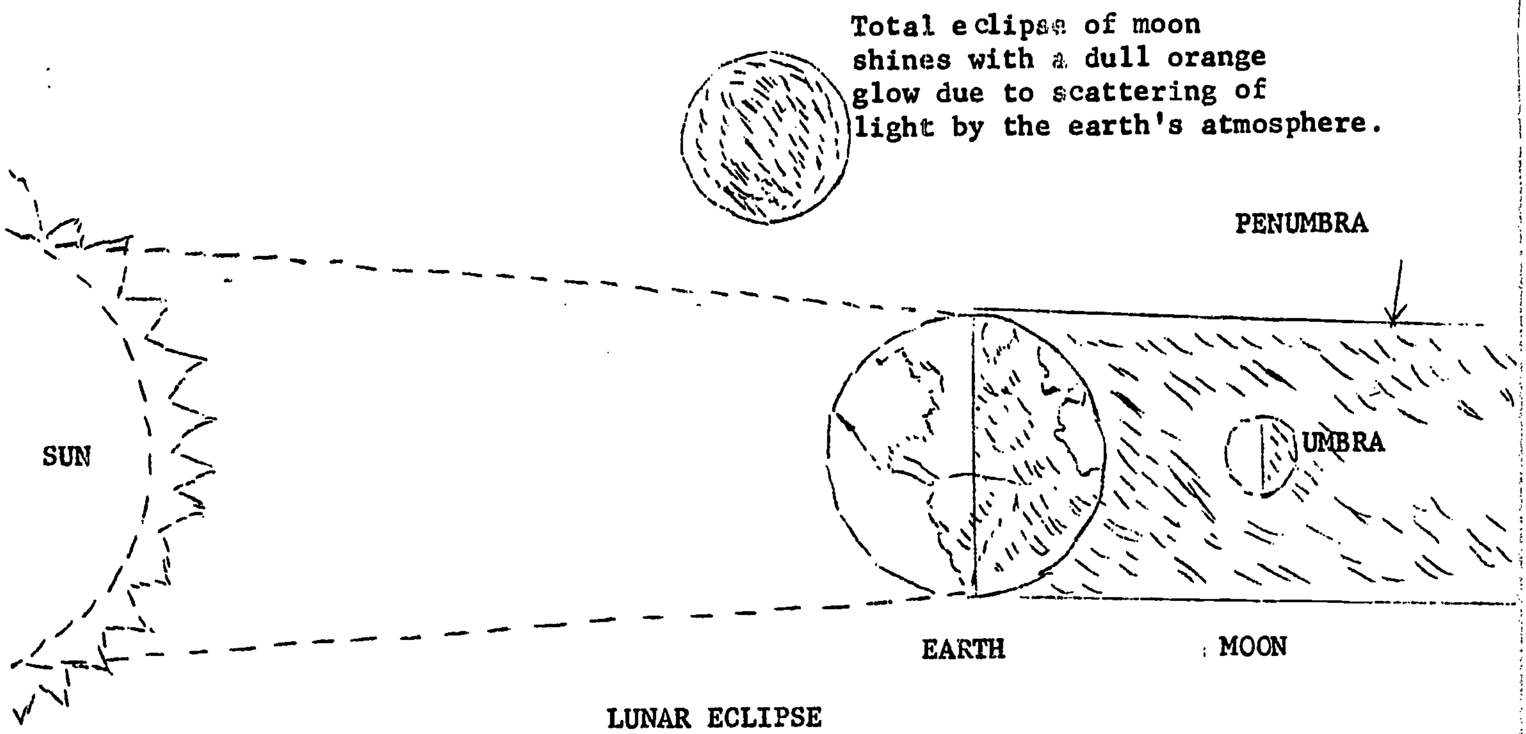


A lunar eclipse occurs when the earth's shadow falls on the moon; a solar eclipse occurs when the moon's shadow falls upon the earth.

D. Materials: a sketch of earth and sun with moon orbit, projector, globe, small ball attached to a string



SOLAR ECLIPSE



LUNAR ECLIPSE

<u>Procedure</u>: Inquire as to whether anyone had seen an eclipse. Develop that the term means "to block off light or cast a shadow." A solar eclipse happens when sunlight is blocked and cannot reach the earth. A lunar eclipse occurs when moonlight is blocked.

Refer to sketch. The dotted circle shows the moon's orbit. Seek someone to draw the moon's position during a solar eclipse; lunar eclipse.

Show the materials. How can we test with our models to see if these eclipses might occur? (Shine a projector on the globe from 10 feet away. Dangle a ball from a string and move it counterclockwise around the globe.) When the moon is between the globe and the projector, it will cast a small shadow on the earth. This is a <u>solar</u> eclipse. When the earth is between the projector and the moon we have a <u>lunar</u> eclipse.

* Why is it that persons living on only a small part of the globe can see a solar eclipse?

* Why is it that people on $\frac{1}{2}$ the earth at one time can see a lunar eclipse take place?

Conclusion: Our chances of seeing a lunar eclipse are greater than seeing a solar eclipse. There are several solar and lunar eclipses a year.

E. Why don't we have solar and lunar eclipses monthly?

Materials: moon models already made

Procedure: Encourage hypothesis to above question. What phase is the moon in during a solar eclipse? (New moon) Lunar eclipse? (Full moon)

If necessary have children recall why the moon-phase demonstrator held the "moon" slightly higher than his head. Some pupils will suggest a moon orbit either above or below the earth's plane of orbit. Both suggestions permit moon-phases but no eclipses.

F. How to view a solar eclipse.

Caution pupils never to look at the sun during a solar eclipse. We may view it indirectly by punching a hole in the center of a piece of cardboard. Then, with back to the sun, focus the sun's rays onto another cardboard. During a solar eclipse, it will be possible to watch the sun's bright disc on the cardboard being obscured by the passing moon.

MAN HAS DEVISED MANY INSTRUMENTS TO HELP HIM STUDY THE STARS AND THE PLANETS

A. Spectroscope - Interested pupils may look up references on the spectroscope and how it operates.

B. Materials: camera with setting for time exposure, tripod

Procedure: Set camera on tripod outside at night and focus on a bright star. Take a time exposure at 15 minute intervals. Look at prints.

Conclusion: A camera can be used in the study of stars.

C. Materials: magnifying mirror (concave)

Procedure: Pull all shades except one, which is left partly open. Face mirror into this light, but point it toward adjacent wall. Maneuver until outdoor view appears on wall.

Conclusion: Pupils will have a concept of how the reflecting telescope works. Point out that we could use a magnifying glass to enlarge the reflected image.

D. Refracting telescope

E. Radio telescopes can be discussed and/or demonstrated.

F. Materials: 2 lenses - each thicker in the middle than at the sides, window, table, waxed paper, clay

Procedure: Stand the thinner lens in a piece of clay at the end of the table. Turn lens so that it faces the window. Move a piece of waxed paper back and forth behind the lens until you find the point where there is a sharp image. Have someone hold the waxed paper there. How does image appear? (upside down)

Stand the thicker lens in clay at the other end of table. Put your eye close to the thick lens. Move the lens back and forth until you can see a clear image on the waxed paper. Take away waxed paper. You have a telescope.

Pupil and Teacher References

* Balet, Jan. Amos and the Moon. New York: Henry Z. Walch, Inc., 1962.

Barr, George. More Research Ideas for Young Scientists. New York: Mc-Graw Hill Book Co., Inc.

Bendick, Jeanne. The First Book of Space Travel. New York: Franklin Watts, Inc., 1963.

* Binder, Otto. Planets: Exploring Other Worlds. New York: Golden Press, Inc., 1959.

Blanc, Sam, Abraham Fischler and Olcott Gardner. Modern Science: Earth, Space and Environment. Holt, Rinehart and Winston, Inc., 1967.

* Bradley, Duane. Time for You: How Man Measures Time. The J.B.Lippincott Co., 1960.

Brandwein, Paul F., and others. Concepts in Science 3. New York, Harcourt, Brace and World, Inc.

Branley, Franklyn, M. Experiments in Sky Watching. New York: Thomas Y. Crowell Co., 1959.

* Coles, Robert R., and Frances Frost. Star of Wonder. New York: McGraw-Hill Book Co., Inc., 1953.

* Crosby, Phoebe. Junior Science Book of Stars. New York: Grosset and Dunlap, Inc., 1963.

Elementary Science Study. Daytime Astronomy. Newton, Mass.: Elementary Science study of Education Development Center, Inc.

* Engelbrektson, Sune. The Sun is a Star. New York: Holt, Rinehart and Winston, Inc., 1963.

Flamarium, Gabrielle, Andre Danyon. The Flamarion Book of Astronomy. Simon Schuster, Inc., 1964.

* Freeman, Mae and Ira. The Sun, the Moon, and the Stars. New York: Random House Inc., 1959.

Gega, Peter C. Science in Elementary Education. New York: John Wiley and Sons, Inc., 1966.

* Hyde, Margaret O. Off into Space. New York. McGraw Hill Book Co., Inc., 1959.

Lauber, Patricia. All About the Planets. New York: Random House, Inc., 1960.

MacCracken, Helen D., and others. Science Through Discovery 3. Singer Science Series: New York: Random House, Inc.

* Polygreen, John and Kathleen. The Earth In Space. New York: Random House, Inc., 1963.

Schneider, Herman and Nina. Science Far and Near 3. Boston: D.C.Heath and Company, 1968.

Wolfe, C. Wroe, et al. Earth and Space Science. Boston: D. C. Heath and Company, 1966.

* Children's reading material

Duplicating and Transparency Aids

The Solar System and Space Travel - Grades 5-9. Milliken Publishing Co., St. Louis, Missouri

FILMS

Why Explore Space?	Churchill
The Seasons of the Earth	Coronet Films
What Causes the Seasons?	McGraw Hill Text Film Division

FILMSTRIPS

The Moon--Our Nearest Neighbor in Space	3 - 2 - C7
Stars and Planets	3 - 2 - C8
The Solar System	3 - 2 - E5
The Stars	3 - 2 - E6
Man Studies the Sky	3 - 4 - A1
The Earth in Space	3 - 4 - B1

MACHINES AND FORCE

Objectives

To develop the understanding of how the six simple machines help men to do work. To create the realization that without some type of force, these machines could not operate.

Allowance for application of knowledge learned to new situations.

Promote scientific thinking.

Concepts

1. People do work when they move things.
2. A machine is any tool or device that helps us do work.
3. Machines make work easier.
4. There are many different kinds of machines.
5. An inclined plane is a simple machine. The force needed to use an inclined plane changes as its tilt is changed.
6. The screw is a simple machine. The force needed to use a screw changes as its pitch is changed.
7. A wedge is a simple machine. The force needed to use a wedge changes as its sharpness is changed.
8. A lever is a simple machine. The force needed to use a lever changes as the length of the force arm is changed.
9. A wheel and axle is a simple machine. The force needed to use a wheel and axle changes as the size of the wheel is changed.
10. Gears are a modification of the wheel and axle.
11. A pulley is a simple machine. The force needed to use a pulley changes as the number of ropes supporting a load is changed.

Motivation

1. Arrange a bulletin board a few days ahead of actual introduction to unit. This bulletin board might ask questions such as these:

    a. What machine helps you open a bottle of soda?
    b. What machine helps you open a can of peas?
    c. What machine helps you dig a hole?
    d. What machine helps you to travel?
    e. Etc.

2. Arrange a bulletin board showing people at work using various machines - simple as well as complex. Allow class to label machines shown with their actual names. Later on in the unit you can label with names of the six simple machines (ex. bottle opener - lever.)

3. Have the children bring in toys that move. Experiment with toys that have springs. Experiment with toys that have wheels. Experiment with toys that move (or parts that move) when they are struck, pushed or squeezed, turned, pulled, blown or thrown.

    --How are these toys moved?
    --How are the parts of some toys moved?
    (We did something to the toy.)

4. Set up a display of books which may spark interest.

5. Show introductory film or filmstrip.

ACTIVITIES FOR MACHINES AND FORCE

PHASE I

PEOPLE DO WORK WHEN THEY MOVE THINGS

A. Discuss things which children have had to move and how they accomplish the task. (Parents?)

----What could have made the task easier? (if no machine was used)

----What made your task easier? (if machine was used)

B. Do you know anyone who makes a living by moving things? What machines do they use to assist? (Children can be grouped to discuss the various possibilities and list them. Lists can be compared after a set interval.)

A MACHINE IS ANY TOOL OR DEVICE THAT HELPS US DO WORK

A. Bring in an assortment of tools. Have the children identify each one. How do these tools help us? (They do work.) Discuss what each tool does.
How is a hammer like a washing machine? (It helps us do work.)
Why can we call a tool a machine? (It helps us do work.)

B. Make a list of different machines the children suggest and have the children describe the work each machine does. Compare the complicated machines with the simple machines. (Complicated machines have many parts; simple machines have few parts.)

C. Make a table display or bulletin board exhibit of tools and devices that the children bring in from their homes.

D. Discuss how machines make a task easier. Ex. What does your mother do if she does not have a washing machine? Is it harder to work the machine or use your hands to wash clothes?

MACHINES MAKE WORK EASIER

A. Have the children try to push thumbtacks into a hard block of wood. Have some children use a hammer. Which is easier?

B. Get a can with a pry-off lid. Have the children try to get the lid off using only their hands. Have the same children try to get the lid off with a screwdriver. Which is easier?

Discuss with the children how tools are used to open cans, clip nails, and cut paper. How is each task made easier?

C. Set two large bowls on the table. Pour equal quantities of sweet cream in each bowl. Have one child mix the cream in one bowl with a clean stick. Have another child use an egg beater to stir the cream in the other bowl. Which child will be the first to treat the class to butter? Why?

THERE ARE MANY DIFFERENT KINDS OF MACHINES

A. Find some machines in the classroom. Ask the children to look for machines that lift, cut or move things (pencil sharpeners, scissors, staple removers, window shade pulley, etc.) Discuss what each machine does.

B. Show pictures of various tools. Group them on a chart:

Things that lift	Things that push or pull	Things that cut, bend or break

PHASE II - SIMPLE MACHINES AND HOW THEY WORK

AN INCLINED PLANE IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE AN INCLINED PLANE CHANGES AS ITS TILT IS CHANGED.

A. Materials: Cardboard box weighted with books; smooth sturdy board about four feet long; nine inch piece of string; low table; several pictures of inclined planes (stairways, a gangway for ships, an airplane ramp, a trucker's loading ramp.) In the absence of pictures, make sketches.

Procedure:

1. Question about pictures (How do people leave the house? How do they get on a ship? Airplane?) What is the similarity between all pictures? Bring out that in each picture there is a slanting way going up or down--ramps or inclined planes. Explain "plane"--inclined plane.

2. Take a string and stretch it from the upper end of the first inclined plane straight to the ground. Hold the string between thumb and forefinger of each hand to mark the distance. Place it over the inclined plane itself. Guide children to note that the distance is greater. Invite children to follow the same procedure with the other pictures.

3. Ask the children why an inclined plane was used in the above case if it makes the walking distance longer. Why not use a ladder instead of stairs or gangplank? (It is easier to walk or push a load up an inclined plane than to walk or pick something straight up.)

4. Experiment with the board, box of books and low table. At first, have two children try to lift the box of books onto the table. Then the board can be placed against the table. Take care to hold the board so that friction between box and board does not cause board to slide upward. Bring out from the two pupils and class that it was somewhat easier using the inclined plane. Encourage other children to experiment to affirm findings. Measure distance from table top to floor and then along ramp.

Conclusion: While it was easier to use an inclined plane, more distance had to be covered.

B. Allow children to stack some books on their desks and create an inclined plane from top book to desk top. Measure direct distance down and then the distance along inclined plane. What is the difference between distances?

C. Materials: smooth board four feet long, six inches wide; several books; table; string; rubber band

Procedure: Let one end of the board rest on the books and the other end on the table. Tie a string around a heavy book. To the string attach a rubber band. Have a child hold one end of the rubber band with the book suspended. Take a large strip of paper and cut it at the exact length of the rubber band. Now place the book at the lower end of the ramp. Have a child pull the book slowly up the ramp. After several trips measure the stretch of the rubber band with another strip of paper. Take measurement while book is in motion. Did rubber band stretch more or less on the ramp then it did when hanging freely?

* Repeat activity using a spring balance instead of rubber band.

D. Materials: string; roller skate; wooden board (ramp)

Procedure: Tie a string to a roller skate and make a loop on the free end. Have a child put a finger through the loop and try to lift the skate straight up from the floor. Now have the same child pull the skate up from the ramp.

Which is easier?
Which method moves the skate through the shorter distance?
Is the easier way always the shorter way?

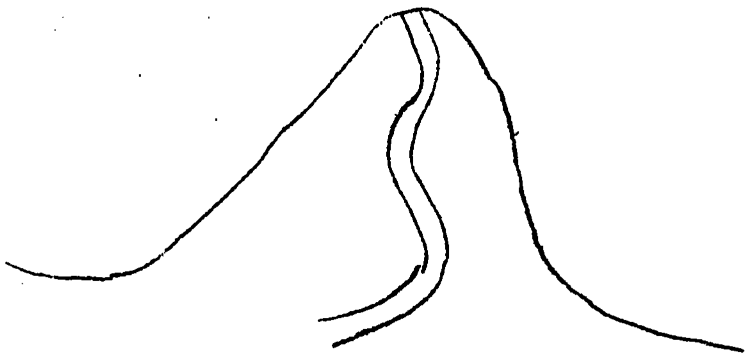
E. Discuss the reasons for building roads so that they wind around mountains instead of going straight up.

F. Materials: roller skates; four foot board; a durable rubber band; a ruler

Procedure: Recall ramps from previous activities. On chalkboard develop that angles of ramps differ somewhat. Sometimes ramps are slanted like this/ ; others like and. Raise conjecture as to whether the degree of slant is related to the force needed to travel up the ramp. By attaching a rubber band to a skate and pulling the skate up the ramp (at various angles) the children will see that the amount of force needed to get the skate up the ramp depends on the angle of the ramp.

Conclusion: Decreasing the slant of an inclined plane reduces the force needed to use it and the converse is also true. Increased distance is the price paid for decreased force.

G. Draw the following sketch on the blackboard.



Inquire if anyone has seen animal trails on steep hillsides that look like lines in the sketch. Why do animals choose a longer, zigzagged route rather than a shorter, straight-up route? Again, bring out the sacrifice of distance to secure decreased effort.

H. Ask class to find pictures for a scrap book showing how inclined planes are used in everyday life.

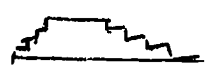
I. Encourage individual children to look for many examples of inclined planes. Each should be ready to tell the class where and how they are used.

THE SCREW IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE A SCREW CHANGES AS ITS PITCH IS CHANGED.

A. Materials: a large sketch for each pair of simple machines

Procedure: Show sketch A. Which planes needs the least force for the barrel to be pushed to the platform? Establish that though less force is necessary to use the longer inclined plane, the load must be pushed a longer distance. Show sketch B. How are the two staircases like inclined planes? (The staircase is an inclined plane with steps.) Which side requires the least force in order to walk to the top?

A 

B 

C Spiral staircases

Again, establish that additional distance is traveled to gain decreased force. Show sketch C. Point out that the two lighthouses are pictured with inside stairways visible; these also, are examples of inclined planes. Emphasize that these inclined planes wind around in a spiral and are called spiral staircases. Draw out similar illustrations the children may have seen. Encourage them to indicate which staircase would require the least force. They should easily recognize again that distance is traded for force.

B. Materials: two large wood screws of equal size but different pitches, screwdriver, hammer, two small blocks of soft wood.

Screw down one end and nail the other end with a nail about the same length as the screw.

Procedure: Establish purpose of the screw. Cite places where used. Hold up the fastened blocks. Have children observe that one end is nailed and the other is screwed down. Which end will be most easily pried apart? Allow a student to try to pry using a screwdriver. The class should conclude that a screw holds more firmly than a nail.

C. Materials: two large wood screws of equal length but varying pitch and one soft wooden block per participating child, screwdrivers, sketches of screws.

Procedure: Show screw sketch illustrating different pitches. Bring out visible differences in threads of the screws; one has more spirals or turns. One has a steeper pitch or greater distance between threads. The steeper pitch is the steeper slant. Compare threads to the spiral staircases in the lighthouses. Let the children hypothesize as to which screw in the sketch would be easier to screw into a piece of wood and which would take more turns with a screwdriver (lower pitch screw.) Permit as many children as possible to try screwing in both screws. Compare results. Which screw took the most turns?

Conclusion: The screw with lower pitch was easier but longer to turn. A sacrifice of time for ease of effort.

D. Materials: two identical pencils, two tacks, two inclined planes cut from white paper, both four inches high, one six inches long, the other nine inches long. (Draw a heavy colored line on the outer edge of the long side on each cut-out.)

Procedure: Place the smaller inclined plane over the larger. Which inclined plane would take longer to use, but less force? Have "pretend" screws made by wrapping inclined planes around two pencils. Secure paper with tape at each end.

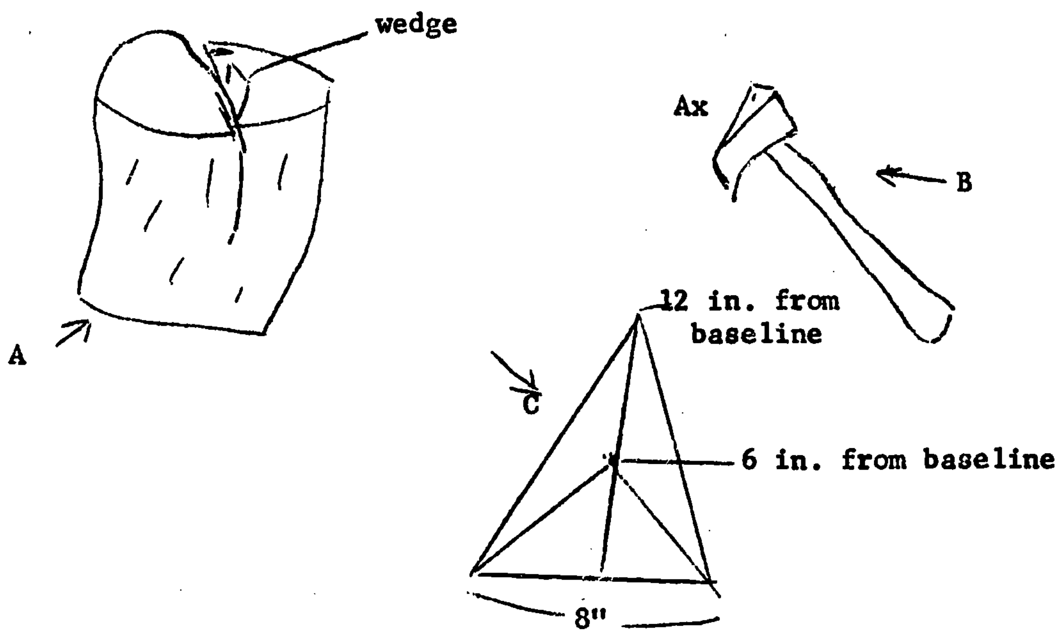
Conclusion: A screw is an inclined plane wound in a spiral.

E. Let class members locate many actual examples of screws for an exhibit table. Have them tell how each screw is used. Some easy to find examples where screws may be wholly or partly employed are:

1. The screw-top lid
2. Corkscrew
3. Monkey wrench
4. C-clamp
5. Nut and bolt
6. Propeller for a toy airplane
7. Desk chair
8. Electric fan
9. Meat grinder

A WEDGE IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE A WEDGE CHANGES AS ITS SHARPNESS IS CHANGED.

A. Materials: sketches of A, B and C below: wedge, ax (picture will do); paper cut out of a wedge as in C, cellophane tape



Procedure: Exhibit a real wedge or sketch "A" to the children. Inquire what the object can be used for. Ask them how a wedge is able to split things apart when struck forcefully. Establish resemblance between a wedge and an ax. (The head of an ax is a wedge.) Refer to sketch C. Take one half of the paper cut out and stick it to the chalkboard. Ask whether a longer or shorter route would require a lesser force to move an object up. Draw out the idea of a longer distance traveled for a gain in force. Now place the other half of the wedge next to the first half. Pause, then reposition both halves together on the chalkboard, sharp and pointing downward. Elicit that a wedge is really two inclined planes placed together. One wedge is sharper because it is longer.

Conclusion: Which wedge would be easier to split things with? The longer wedge is the sharper wedge.

B. Materials: two wooden stakes of the same width but varying lengths

Procedure: Ask if anyone has gone camping and has pitched a tent. Bring out how the ropes are tied to stakes. Display the two wooden stakes and ask which would be easier to drive into the ground. Let them think through faulty procedures. As an example, a patch of ground will need to be selected which is of fairly uniform consistency, where each stake was driven in. Try it in a suitable area.

Conclusion: A longer wedge is required to gain force in pushing apart the ground.

C. Materials: knife, scissors, needle, nail

Procedure: Invite different children to describe why the above materials can be considered wholly or partly wedges. Have them compare the cutting or puncturing effect of the regular (sharp) and opposite (dull) portions of these materials.

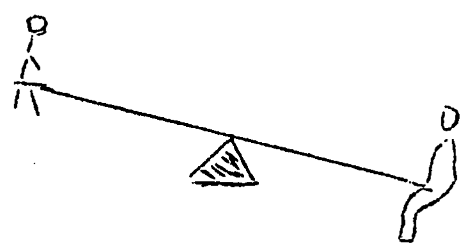
D. Set up a bulletin board of pictures that illustrate many unusual wedges. Let pupils explain why each is partly a wedge. Some examples are:

1. the front of an airplane
2. the bow of a boat or ship
3. animal claws
4. woodpecker's bill
5. teeth
6. plow
7. head of a rake
8. spade
9. fork
10. can opener

A LEVER IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE A LEVER CHANGES AS THE LENGTH OF THE FORCE ARM IS CHANGED.

A. Problem: Two boys are on this seesaw:

Draw the seesaw's position of the boy on the right as heavier than the boy on the left. What would happen if both boys were the same weight? Allow children to explain their answers.
Is it possible for the lighter boy to make the heavier boy rise on the see-saw? How? Allow children to draw seesaw the way they think it ought to be:



Demonstrate: Allow two children to demonstrate by using a four foot board and fulcrum. A large and smaller child should be chosen. Experiment with fulcrum in various positions so pupils can check their drawings.
Tell pupils the proper name for the fulcrum. Establish that the side of the board to which the force was applied is called the force arm. The seesaw is an example of a simple machine called a lever. If continual reference is made to the portion of the board carrying the load, introduce the words load arm.

B. Materials: hammer, nail partly driven into a block of wood

Procedure: Tell the group they are going to discover more about levers. Request that someone try to extract the nail with his fingers. When he fails, ask which simple machine could help. As the claw of the hammer is placed under the nail head, and he begins applying force to the handle, stop him before the nail can be extracted. Note that his hands are near the end of the hammer handle. Ask why. Have the child shift his hand and apply force at the beginning of the handle. It will be difficult, if not impossible, to extract the nail. How can the extraction be made easier? (Apply force at the end of the handle.) Point out that the hammer is a lever. Rock the hammer back and forth on its head; help them determine where the fulcrum is. (Where the hammer head claws touch the wood.) The handle serves as the force arm. Remind everyone what happened previously when the force arm was made longer. (Force was increased.) Have child easily extract the nail.

Conclusion: Increasing the force arm length makes it possible to exert less force. Work is made easier.

C. Materials: can opener, small adjustable end wrench, clean tin can with one end intact, thick rubber band, ruler

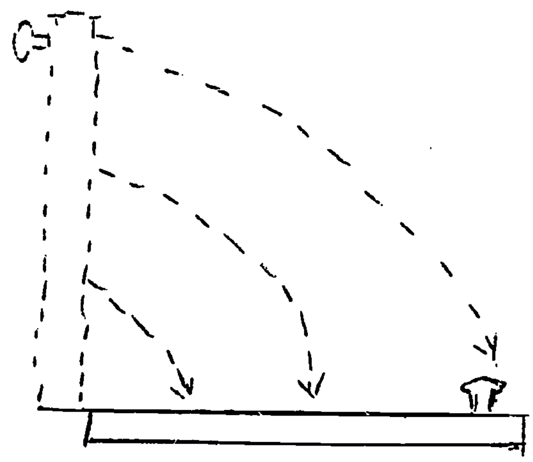
Procedure: Ask the children to demonstrate that increasing force arm length permits work to be done with less force. Provide assistance and clues as needed. Students should be able to design a demonstration that includes:

1. piercing the tin can with a can opener
2. piercing can top with adjustable end wrench attached to handle (wrench used to lengthen handle-force arm)

A rubber band may be affixed to the end of the handle in both cases to show amounts of applied force. A ruler may measure approximate stretch (force) required to pierce the can.

Conclusion: Increasing the force arm length permits less force to be exerted in doing work.

D. Materials: thin rubber bands, thumb tacks, ruler, classroom or closet door, sketch of drawing below



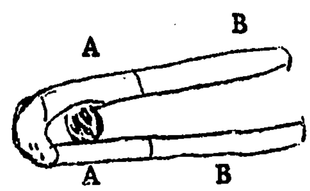
Procedure:
Present sketch. Ask for identification of same. What simple machine is like a door? (lever) Find fulcrum (hinges). Find the door knob in sketch and note location. Trace the path of the hand when actually opening the door (largest arc). Show that if the door knob were in position A, the arc distance for opening and closing the door would be lessened; even less at point B. Ask why the door knob, then, is usually placed at the outside of a door. Someone might answer that it makes locking more convenient. Press for amount of force required in the opening and closing activity. Children might experiment by thumbtacking a rubber band to a door in three different positions. A ruler may assist in recording the degree of stretch (force) needed to move the door.

Conclusion: Increasing force arm length permits less force to be exerted in doing work. A greater distance is traveled to reduce effort.

E. Materials: nutcracker, several nuts, scissors, tinner's snips, cardboard, sketches–below

Procedure: Show examples of double levers. Allow pupils to point out fulcrum and force arms. Let them point out the best place to apply the force. (Increase force arm length.) Make sure that students realize that placing material to be cut as close as possible to the fulcrum has the effect of increasing force arm length.

Conclusion: Same as D. Plus, when using a double lever to cut a material, the object is more easily cut when placed close to the fulcrum.



Nutcracker

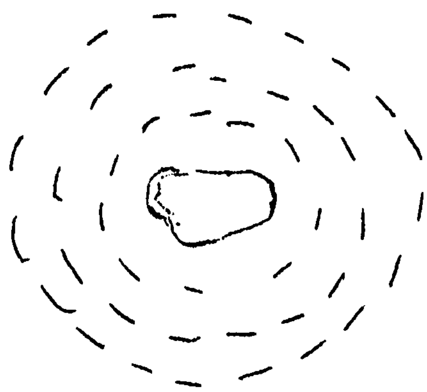
F. Materials: ruler, string, book

Procedure: Tie a string around a book. Hang it from a ruler at the two inch mark. Life the end of the ruler with one finger. How heavy does it feel? Move book to four inch mark, the six, eight, and ten inch marks. At which place did you need the least force to move the book? Where was the fulcrum? (end of table)

A WHEEL AND AXLE IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE A WHEEL AND AXLE CHANGES AS THE SIZE OF THE WHEEL IS CHANGED.

A. Background: The primary function of the wheel and axle is to transform forces and motion. This type of wheel and axle is essentially a continous lever. A small force applied to the rim of the wheel makes it possible to exert a much larger twisting force on the axle. A force applied to the axle makes it possible to multiply distance.

Procedure: Put this sketch on the board: (but cover until needed)



Problem: Three boys decided to run a race. In every race they ran in the past, they always had a tie. Today they decided to run around a pond. One boy came in first, another second and the other third. Why do you suppose this happened? Allow someone who knows to explain by using the chart. (Different relative distances were involved.)

Conclusion: The distance is shorter to travel when one goes directly around an area or object. The closer to the object, the shorter the distance traveled.

B. Materials: windlass, books, string, rubber band, ruler

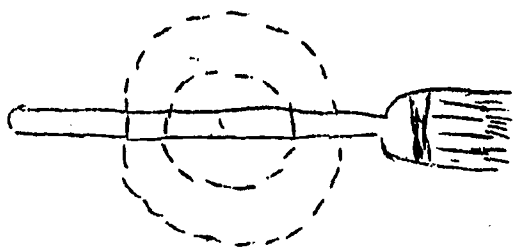
Procedure: Inquire as to whether anyone has ever used a well to get water, or knows how a well operates. Let several pupils explain. (Make sure they include pushing the handle around.) Tell them this is an example of a simple machine called a wheel and axle or a windlass. They are attached and unlike a wagon wheel and axle.
Demonstrate or allow a pupil to demonstrate the workings of the windlass in class. It is common to have a handle near the wheel's outer edge. Press for reasons. If none are satisfactory, ask about what happens to required force when distance is increased. Have class compare model windlass to sketch. Have children realize that the handle will probably be at point C. Will less force be required as handle distance from the axle is increased? What must be done to see? (A rubber band and ruler can again be used to measure the amount of force required to lift books at the three positions.)

Conclusion: Lengthening the handle distance from the axle made it easier to lift a load.

C. Materials: doorknob, screwdriver, broom, masking tape

Procedure: Identify examples of wheel and axles in classroom. (Which part is the wheel and which is the axle?)

Take the doorknob off the door so that only the axle is attached. Have someone try to open the door without the knob, then with the knob. Develop the idea of distance and force.
Hold up a screwdriver and identify the wheel and axle. Where would the applied force be most powerful - at the shank, or the handle? Why? Try it. You can reduce the friction by using masking tape around each part.
Exhibit broom or pole. Refer to chalkboard sketch:



Explain that this can be considered a spoke of two steering wheels, one large, one small. Which one would be easier to turn? Why? Allow one child to hold stick at inner markings and another at outer markings. Upon cue, each child will try to turn the broom in opposite directions. Force should be applied smoothly and without excess strain.

Conclusion: The further the distance from the axle, the easier it is to turn the wheel, but a greater distance must be covered.

D. Ask everyone to find examples of machines that are at least partly the wheel and axle kind and explain how they work.

1. pencil sharpener
2. tricycle (front wheel)
3. pencil sharpener
4. pepper mill
5. egg beater
6. skate key
7. fishing reel
8. TV dials

GEARS ARE A MODIFICATION OF THE WHEEL AND AXLE

A. Materials: egg beater

Procedure: Have children notice the bit wheel of a beater. See how they fit into the teeth on the little wheels. The wheels with teeth are gears. Notice how a handle turns the big gear. What is the purpose of turning the large gear? (smaller gears) When the smaller gears turn, what else turns? (beater blades) Make a mark on one of the blades of the egg beater. Turn the handle slowly for one revolution. Count how many turns the blade makes. (five to one ratio)

Conclusion: When a big gear turns a smaller gear the work is speeded up.

B. Materials: two bicycles

Procedure: Allow children to observe how the gears of a bicycle work. When a bicycle is peddled, you are turning a large gear which in turn moves a smaller gear which is turning the rear bicycle wheel. The rear bicycle wheel moves the bicycle. (Point out the parts by referring to an actual bicycle or diagram.) Compare taking two steps on foot with two steps on a bicycle. Use another bicycle with larger or smaller wheels than the first.

Conclucion: With a bicycle you gain speed and distance. The larger the wheel, the further and faster you go.

A PULLEY IS A SIMPLE MACHINE. THE FORCE NEEDED TO USE A PULLEY CHANGES AS THE NUMBER OF ROPES SUPPORTING A LOAD IS CHANGED

A. Display pulley. Show that it has a movable wheel and a stationary axle.

B. Materials: twine or light rope, bucket or book, spring balance or rubber band

Cite and discuss some pulleys children may be familiar with.

Procedure: Using a hook or nail on the wall in the classroom, let children devise a way in which a toy bucket can be raised or lowered (using twine or light rope).

Does it take less or more force to lift something with a pulley or without one? How can we tell using a rubber band and a ruler? The rubber band will stretch more with the pulley due to friction. How can friction be decreased? (oil axle)
Develop that it is more convenient to pull in a downward direction than up because we can use the weight of our bodies to help. A pulley makes moving things easier and more convenient.
A pulley that stays in one place is a <u>fixed pulley</u>.

<u>Conclusion</u>: A fixed pulley does not reduce force.

C. Construct a pulley going sideways. Discuss values and uses of this type of pulley.

D. <u>Materials</u>: movable pulley, fixed pulley, bucket, spring balance or rubber band, yardstick

<u>Procedure</u>: Establish that occasionally a single pulley is so arranged that it moves up and down with the load. This is called a <u>movable pulley</u>. Do these two <u>silent</u> demonstrations and then ask why a movable pulley might be used to do lifting. Demonstrate the degree of force needed with a fixed pulley, then with a movable pulley. To show why the movable pulley uses less force, ask a child to place a yardstick through the bucket handle and lift it. Have him place one end of the yardstick on a desk top and hold the other end horizontally with bucket centered. Bring out that he is supporting only half the bucket's weight. Establish that in a single, fixed pulley the load is supported by a single strand, but in the movable pulley the load is supported by two strands. Therefore, only one half the force is required.

<u>Conclusion</u>: A movable pulley requires less force than a fixed pulley and is therefore easier to use.

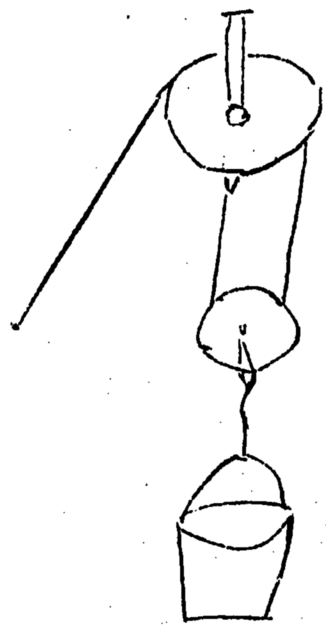
E. Show that decreased force is gained at the expense of increased distance by setting up a fixed and a movable pulley. Set up a table such as the following:

	Fixed Pulley	Movable Pulley
Distance string pulled	1 foot	2 feet
Distance load raised	1 foot	1 foot

F. Materials: a combination fixed and movable pulley, bucket

How can a fixed and movable pulley be used together? This would give two advantages: less effort and a pull downward.

Demonstrate - show diagram



G. Arrange a two-strand pulley system, or block and tackle. Then set up a four-strand system. Lift a brick first with a two-strand system, then with the four. Which is easier to use? (four-strand system)

Possible Culminating Activities

1. Have students make booklets in which they will sketch simple machines and then paste in pictures which are examples of each particular one.

2. Think of at least one new way you could use each simple machine.

Reference -- Bibliography

* Blough, Glen O., Doing Work, New York: Harper & Row Publishers, 1959.

Gega, Peter C., Science in Elementary Education, New York: John Wiley and Sons, Inc., 1966.

Navarra, John G. and Joseph Zafforoni, Science Today For The Elementary School Teacher, New York; Harper & Row, 1960.

* Parker, Bertha Morris, Machines, New York: Harper & Row, 1959.

Parker, Bertha Morris, Science Experiences: Elementary School New York: Harper & Row, 1958.

* Pine, Tillie S. and Joseph Levine, Simple Machines and How We Use Them, New York: McGraw Hill Book Co., 1965.

Sharp, Elizabeth N., Simple Machine and How They Work, New York: Random House, 1959.

FILMS

1. How Wheels Help Us.
2. How Machines and Tools Help Us. Coronet Films
3. Machines Do Work. McGraw-Hill Book Company
4. Moving Things On Land. McGraw Hill Book Company
5. Simple Machines: Pulleys. Coronet Films

FILMSTRIPS

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1. Machines For Daily Use.
2. Finding Out About Simple Machines. Society for Visual Education.
3. Machines and Tools Help Us Work. Society for Visual Education
4. Pulleys. Jam Handy Organization
5. Simple Machines. McGraw Hill Book Company

Communities of Life

Objectives

1. To comprehend the continuity of life within a given environment.
2. To understand that there is a balance between plants and animals in a given environment before said environment is disturbed by man.
3. To become aware that animals adapt to new environments or perish. Some animals, however, can alter a given environment.
4. To become aware that there are many types of plant and animal communities.
5. To promote scientific thinking.

Concepts

1. A pond is a community of living things both in and around the water.
2. Animals affect their community.
3. Life is affected by its surroundings.
4. Animals and plants depend upon one another for survival.

Motivation

A review of work previously covered by means of categorizing.

A. Materials: about 15 groups of pictures of plants and animals of various phyla; pencils; paper

Procedure: For this activity the children might work in pairs for maximum participation while conferring. A large variety of pictures of "living things" should be given to each pair of pupils. The pictures might first be separated into kingdoms and then further subdivided. (Sub-categories may be predetermined by the entire class or left to the individual pairs to decide.) After sub-categories are determined and pictures are arranged in piles, one child ought to write a listing chart for his pictures while his partner dictates. (They might alternate jobs.) The chart's should vary.

Allow several charts to be read aloud and pictures shown. Allow for class discussion, disagreement, etc. Large categories may be written on the chalkboard in chart form.

A class listing process may ensue if desired.

B. A bulletin board may be created showing pictures of various forms of life. Pictures might be made by children and placed in such a way that a true-to-life living situation is represented. (Encourage pictures of plants as well as animals.) Allow a group of children to arrange pictures on bulletin board.

A POND IS A COMMUNITY OF LIVING THINGS BOTH IN AND AROUND THE WATER.

The purpose of color in animals or plants usually is to conceal, disguise or advertise.

Every living organism possesses some body parts which are adapted for the life it leads.

Each species is adapted or is in the process of becoming adapted to live where it is.

A pond is a small body of water containing many different forms of life, which, if undisturbed, are in balance.

Some forms of life are very small and can be seen only with a microscope.

The children should be made aware of the above. The following ways may be used as methods.

A. Ask: What is a pond?
Is a pond non-moving water?
Does a pond contain life?
Is there life around a pond?

Discuss pond life, vegetation (plants), sources of water, and above questions.

Pond life may include:

Animals	Plants
frogs	mosses
hydra	algae
water skippers	cattails
aquatic snails	water lilies
crayfish	pond scum (spirogyra)
toads	reeds
spiders	grasses
flies	
grasshoppers	
turtles	
snakes	
salamanders	
snails	

Some examples of ponds are trapped rain water, dammed streams, sink holes, storage water, and trapped drainage water.

B. Field Trip

Materials; dip nets (can be made out of old stockings and coat hangers); jars with lids; containers for insects; thermometers

Procedure: Take a planned field trip to a pond; provide for transportation, supervision, rules of conduct, safety rules, permission and equipment. Have students take temperature readings at different depths and record the data. Look for all of the different forms of life. Gather a few specimens of the following:

water samples
algae
mosses
insects
animals
life from covered rocks

Record unusual examples of coloration.

C. Ask: What is the source of water that was in the pond?
What kinds of animals and insect life were found?
What kinds of plants were found?
Could there be life in the water that we cannot see?
How can we examine the life?

Materials: microscope; dropper; slide; cover glass

Procedure: Put a drop of water collected from the pond on a slide and cover it with a cover glass. Place under a microscope.

Questions which may be asked are:

What can be seen under the microscope?
Can there be life we can't see?
What would happen if the pond dried up?
Is there any form of life on the rocks? (examine)
How does water temperature vary?
Is it important to pond life?
Why are algae and other plant life important?

Explanation: Temperature is important to life. If the pond is deep, there will be different types of life living at different depths. Algae and other plant life serve as food for fish and some water insects.

D. How was life colored so as not to be easily seen?

Materials: microscopes or magnifying glasses; wood, rock, pond water, tap water

Procedure: Set up microscopes or use magnifying glasses to observe the material of the wood, lichens on the rock, and the pond water more closely. Observe tap water as well.

Why should you not drink pond water?
Why is it safe to drink tap water?

Explanation: City water has been purified by killing organisms in water. Review the purpose of each organism in the pond, pointing out how organisms are dependent on each other. For example, the fish eat the plants, but they also make fertilizer that plants need in order to grow.

*E. If you were to put some soil, a few snails and some water plants into a jar, would you have a small pond? Explain.

ANIMALS AFFECT THEIR COMMUNITY

Animals are dependent on one another and plants for food.

The smaller the animals, the more likely it is that there will be a larger number of them present in a community.

Larger animals may consume many small animals in order to satisfy their hunger.

The fittest survive.

When the supply cannot meet the demand, a change of some kind must occur in the community.

Water plants are important to an aquatic community.

"Pyramid of number" means that there are always more small animals in an environment which serve as food for the larger animals, who in turn are food for even larger animals.

The above points may be illustrated through the following series of activities.

A. Set up an aquarium. Obtain from a swampy region, a lake, or a stagnant pool some rather scummy water. Be sure to get some of the green plants (algae) which live in the water and place these in aquarium. Also attempt to collect some snails, daphnia, and other organisms found in stagnant water. Include some rocks and a small fish. (You now have a microcosm, a small world.)

What is this? What does it show?
How is it different from a regular aquarium?
How many different kinds of life do you see?
What is happening in it?
What change do you think will take place in the jar?
Is this a microcosm? (yes)
  -What part do the animals play?
  -What function do the plants have?
What changes would you expect to take place in a day, a week, or a month?

B. Explanation: During the beginning observations the students will not observe much of a change. Perhaps the initial observations could be followed by discussing these questions.

Why hasn't there been much change?
Is the life in the aquarium balanced now?
Do you think there will have to be an imbalance before we detect any change?
What does the fish eat?
Does the plant take care of anything else other than itself?
Where does the plant get its food?

C. After some time the fish will die.

Discuss:

Why did fish die?
-Was he sick?
-Was he getting anough food?
-What did he eat? (how much at once?)
-Lack of oxygen?

What will happen now to the fish if we leave him there? (Leave expired fish in the jar.)

D. After a few days:

How do we account for the rise in population of the smaller animals?

What evidence do we have that one animal is dependent upon another for food?

Explanation: After some time there will be a definite change, owing to the fact that the organism eating the dead fish multiply rapidly, but when the fish has been eaten they begin to die.

Ask: How did the food supply effect the population?

E. Keep the aquarium for several more days. Note any changes in plants.

-Why are plants changing?
-How did the plants contribute to the microcosm?

Explanation: To make food oxygen for the animals. What effect did the death of the animals have on the microcosm?

LIFE IS EFFECTED BY ITS SURROUNDINGS

Points to establish:

Certain environmental factors determine community types.

Some of the types of communities are on land and some in water.

Land communities can be subdivided into forests, bogs, swamps, deserts and others.

A community is a collection of living organisms which have mutual relationships among themselves and their environments.

All living things have certain requirements that must be met by their surroundings.

Habitat is a place where an animal or plant naturally lives or grows.

The main purpose of this unit is to show that different environments are needed to sustain different types of life.

The following are suggestions for various environments which can be set up in the classroom.

The children should be made aware of the interdependence of life in each situation. Control situations may be arranged to show what a lack of plants will do to animals and vice versa.

Procedures for Setting Up Plant and Animal Environments - Unheated Aquarium

Set aside in separate containers enough water to fill the aquarium. This water should be allowed to stand uncovered for twenty-four hours to reach room temperature and also to aid in the removal of chlorine. It is advisable to purchase the animal life a day or two after the aquarium has been set up. This gives the plant life ample time to take root.

1. Obtain and use a rectangular water-tight glass container or aquarium.

2. Wash container with soap and water and rinse container thoroughly with clean, clear water.

3. Wash sand or gravel thoroughly and spread evenly over bottom of the aquarium.

4. Wash plants carefully under running water.

5. Tie small weights or stones on plants to help anchor them in the sand.

6. Arrange the plants attractively and firmly in the sand.

7. Place a sheet of paper (newspaper or construction paper) over plants and sand to prevent plants from being uprooted by filling the aquarium with the "aged" water.

8. Cover aquarium and allow it to stand for a period of several days.

9. Place fish and other animals in aquarium.

10. Place glass cover over top of aquarium to keep clean (not to be airtight.)

11. Keep fish in healthy condition by placing them about once a month in a salt water solution. (1 teaspoon common salt and 1 teaspoon Epsom salt to 1 gallon of water for 24 hours.)

12. Feed only recommended foods.

    Note: Electric aerator and filter are helpful in keeping the water clean for animal life and reducing necessity for plants.

Temperature Controlled Aquarium (Tropical Environment)

Fill clean containers with tap water and allow them to remain uncovered for a period of 24 hours. This process should allow the water to reach room temperature (75°F.) and also aids in the removal of chlorine gas. It is advisable to purchase all animal life a day or two after the aquarium has been properly prepared. This will afford ample time for the plants to take root.

1. Obtain and use a rectangular water-tight glass container or aquarium.

2. Wash container with soap and water and rinse thoroughly with clean, clear water.

3. Wash sand or gravel thoroughly and spread evenly over bottom of the aquarium.

4. Wash plants carefully under running water.

5. Tie small weights or stones on plants to help anchor them in the sand.

6. Arrange the plants attractively and firmly in the sand.

7. Place a sheet of paper (newspaper or construction paper) over plants and sand to prevent plants from being uprooted while filling the aquarium with the aged water.

8. Plug into a nearby electric outlet a combination aquarium-heater-thermostat. Hang it over the side near one corner of the aquarium, being careful not to submerge the top. In the corner, place an aquarium thermometer. Allow a week or ten days to adjust the thermostat until the water temperature stabilizes between 72° and 80°F.

9. Place guppies, angel fish, or other tropical fish into the prepared aquarium. Add several snails or a Bronze Catfish to act as scavengers.

10. Place glass cover over top of aquarium to keep clean (not to be air-tight.)

11. Keep fish in healthy condition by placing them about once a month in a salt-water solution (1 teaspoon common salt and 1 teaspoon Epsom salt to 1 gallon of water for 24 hours.)

12. Feed only fish food or diet recommended by authorities.

Note: Electric aerator and filter are helpful in keeping the water clean for animal life and reducing the necessity for plants.

ANIMALS AND PLANTS DEPEND ON ONE ANOTHER

Several environments may be simulated.

A. Aquarium

Materials: 5 gallon container
4½ gallons of water
10 lbs. of sand or gravel
1 feeding ring
1 sand trough
10 plants (Sagittaria, Elodea, Myriophyllum, Vallisneria, Cabomba)
1 or 2 tadpoles
2 small fish (goldfish or sunfish)
6 to 12 snails
1 piece of glass for cover (not to be air-tight)
1 package of goldfish food
1 siphon for removal of waste from the bottom of aquarium
1 thermometer
1 electric filter system (optional)
1 electric heater (optional)

B. Woodland Terrarium

Materials and procedure

1. terrarium with 5 gallon capacity
2. layer of pebbles on the bottom of the container.
3. layer of sand on top of pebbles
4. layer of rich soil on top of sand
5. Arrange plants attractively in the soil and water thoroughly. Plants which can be used are: moss, lichens, liverworts, partridge berry or wintergreen, small ferns, creeping Charlie or grass.
6. Place animals in container. Animals which may be used are: snake, frog, newt or turtle.
7. Place a screen over container.
8. Water is needed to maintain a moist soil condition.

C. Desert Terrarium

Materials and procedure

1. Acquire a 5 gallon terrarium
2. Place dry fine sand in the container.
3. Arrange plants attractively and firmly in the sand (various types of cacti.)

4. Place a small dish of fresh water on the sand for the animals (collared lizards and chameleons).
5. Place animals in the container.
6. Place screen cover over container.
7. Water bi-weekly for west or south exposure, less frequently for east or north.
8. Change sand when odors are noticed.

D. Semiaquatic Terrarium

<u>Materials and Procedure</u>

1. Acquire terrarium.
2. Place pebbles on the bottom of container, Build up one end with sand or gravel to height of several inches above water line.
3. Place soil on top of the gravel for swamp plants.
4. Arrange plants attractively and firmly in the soil. Plants which may be used include: moss, partridge cherry, small ferns, arrowhead, lichens, liverworts, creeping Charlie or common grasses.
5. Carefully pour the water into the shallow end of container and maintain this level.
6. Place animals in environment. Animals which may be used include: turtles, salamander or newt, frog or crayfish, toad.
7. Place glass cover over container (not air-tight).

<u>Questions geared toward aquarium care and understanding of procedure</u>.

Why are snails needed in an aquarium?

(They eat the small green algae, scummy plants that collect on the side of the tank.)

Why clean tank?
Why must gills of fish be kept clean?
How do fish breathe?
Why allow water to stand for several days before placing fish in aquarium?

Why were plants added to aquarium?
Why is it necessary to add fish food?
Why would the fish naturally eat?
What do plants make that the fish can use and vice versa? (brief mention)

<u>Explanation</u>: Plants make oxygen and food and fish produce carbon/dioxide and waste products. The aquarium is probably not balanced, so that food must be added to it from time to time for the fish.

Comparison of Aquarium and Terrarium

How does the life found in the aquarium differ from that found in desert and bog terrarium?

What kind of conditions do the fish, the turtle and the frog or lizard have to have in order to survive in their particular habitats?

What kinds of conditions do bog plants need in order to grow well?

What kind of food does the fish, the lizards or the turtles eat?

What do you think would happen to the turtle if you left him in the desert habitat; to the lizard if you put him in a bog habitat?

Culminating Activity

Depth study of individual animals.

Divide class into heterogeneous groups of 5, Each committee will study one animal of their own choosing which had been observed during unit.

The committee chairman should be given a question sheet after teacher finds out animal selected. Questions which might be asked:

1. How does your animal develop to adulthood?

   (simply increases in size; undergoes change within a cocoon where it developes wings; progression visible change - frog; etc.)

2. How does your animal get its food?

3. What does your animal look like?

4. How does your animal care for its young?

5. What are the enemies of this animal and how does the animal protect itself?

6. etc.

Questions may be assigned to individuals who are responsible for writing the answer on the answer sheet and initialing it.

Reports will be presented to the class after each group is satisfied with its individual results. Pictures should supplement reports.

The committees should be ready to report after 3 committee meetings of about 30 working minutes each.

It is essential that ample reading matter be present in the classroom at the time of the committee meetings.

OBSERVATION CHART

	CHANGES IN ANIMAL LIFE	CHANGES IN PLANTS	CHANGE IN WATER COLOR	OTHER CHANGES NOTICED
MONDAY				
WEDNESDAY				
FRIDAY				
MONDAY				
WEDNESDAY				
FRIDAY				
MONDAY				
WEDNESDAY				
FRIDAY				

References

* Broekel, Ray, The True Book of Tropical Fishes, Chicago, Children's Press, Inc., 1956.

* Buck, Margaret Waring, In Ponds and Streams.

Carin, Arthur and Robert B.Sund, Teaching Science Through Discovery, Columbus, Charles Merrill Books, Inc. 1964.

* Carter, Katherine J., Hoppy Long Legs, Austin, Steck Co., 1963.

* Fenton, Carroll Lane, and Evelyn Carswell, Wild Folks At The Pond, New York, John Day Co., Inc., 1947.

* Harris, Louise D. and Norman D. The Little Read Newt, Boston, Little, Brown and Co., 1958.

Hausman, Leon A, A Beginner's Guide To Fresh Water Life, New York, G. T. Putnam's Sons, 1950.

* Hogner, Dorothy Childs, Odd Pets, New York, Thomas J. Crowell Co. 1951.

* Hogner, Dorothy Childs, Snails, New York, Thomas J. Crowell Co.,1958.

Kane, Henry B. The Tale Of A Pond, New York, Alfred A. Knopf, Inc. 1960.

* Kay, Dorothea, A Child's Book Of Fishes, Chicago, Maxton Publishing Corp., 1953

* Lavine, Sigmund A., Wonders Of Animal Disguises, New York, Dodd, Mead and Co., 1962.

* Lavine, Sigmund A., Wonders of the Aquarium, New York, Dodd, Mead and Co., 1956

*McClung, Robert M., Bufo, The Story Of A Toad, New York, William Morrow and Co., Inc., 1954

* Meeks, Esther Macbain, Jeff and Mr. James' Pond, New York, Lothrop, Lee and Shepard Co., Inc., 1962

*Miller, Patricia K. and Iran L. Seligman, Big Frogs, Little Frogs, New York, Holt, Rinehart and Winston, Inc., 1963.

Navarra, John Gabriel and Joseph Zafforoni, Today's Basic Science, New York, Harper & Row Publishers, 1967.

* Parker, Bertha Morris, The Golden Treasury of Natural History, New York, Simon and Schuster, Inc., 1952.

* Pels, Gertrude, The Care of Water Pets, New York, Thomas Y. Crowell Co., 1955.

Schneider, Herman and Nina, Science Far and Near 3, Boston, D.C.Heath and Co., 1968.

* Schoenknect, Charles A., Frogs and Toads, Chicago, Follett Publishing Co., 1960.

Waller, Robert (coordinator), Science, Ill: Elk Grove Township District 59.

* Zim, Herbert S., Frogs and Toads, New York, William Morrow and Co., Inc., 1950.

Films

Pond Life	-	Encyclopedia Britannica Films
Aquarium Wonderland	-	Pat Dowling Pictures
Life in An Aquarium	-	McGraw-Hill Book Co., Inc.
We Explore The Woodland	-	Stoneham

Filmstrips

Looking For Animals	3 - 1 - D1
How Amphibians Get Their Food	3 - 1 - E2
How Fish Get Their Food	3 - 1 - E3
* Animals of The Pond	3 - 1 - B3
* Living Things Need Other Living Things	3 - 2 - C5